MACHINERY.

November, 1902.

SHOP CONSTRUCTION.—2.

THE GUIDING CONDITIONS—GENERAL FEATURES OF THE BUILDINGS.

OSCAR E. PERRIGO.

Having arranged and planned the buildings for carrying on the work for which our plant is designed, making each of a size large enough for the equipment to be installed and the number of men required to operate it; and having placed the several buildings in convenient adjacency for economically passing the work through them, from the raw material to the finished product, let us now consider the construction of the buildings planned.

Manufacturing buildings are erected for utility rather than ornament, and the latter characteristic is always made secondary to the practical question of best fitting them for the special work to be done in them. To this end one must be guided by several well-known conditions. First, the buildings should be strong enough to bear the weight and withstand the strain of the machinery operated in them, and the materials used in manufacturing, with which they are loaded. This load frequently varies within a wide range as to weight at different times, and is also constantly being shifted from one point to another, so that provision must be made for this condition. Second, the building must be of such construction as to be amply rigid for all purposes, and to a certain extent be elastic enough to remain uninjured under the shocks that it is liable to undergo. Third, there should be ample opportunity for ventilation, yet not unnecessary height, as the expense of heating would be needlessly increased.

Fourth, ample provision should be made for light, for which purpose the windows should be placed at short intervals and extend nearly to the ceiling. At the same time an extravagant use of glass will also increase the cost of heating. Fifth, the floors should be of such strength and material as to bear whatever weight is to be put upon them, either regularly or temporarily. Sixth, Numerous exits should be provided for the use of employees in case of fire. This becomes more imperative as the number of employees increases in proportion to the area of floor surface; as for instance, in factories, particularly where boys and females are employed.

Seventh, the roofs should be so constructed as to bear the weight of snow in winter, as well as the pressure of high winds; and they should be so designed as to give a minimum amount of after-expense from deterioration and from leaking, the latter cause usually costing much more from damage to stock and machinery than for repairs to the roof itself.

For manufacturing buildings in general there is probably no construction more satisfactory in every respect and that answers all the usual conditions better than brick walls and an iron roof. The walls should be of a thickness proper to the size and purposes of the building, and, except when the building is for light work, should be strengthened by buttresses placed between the windows or groups of windows.

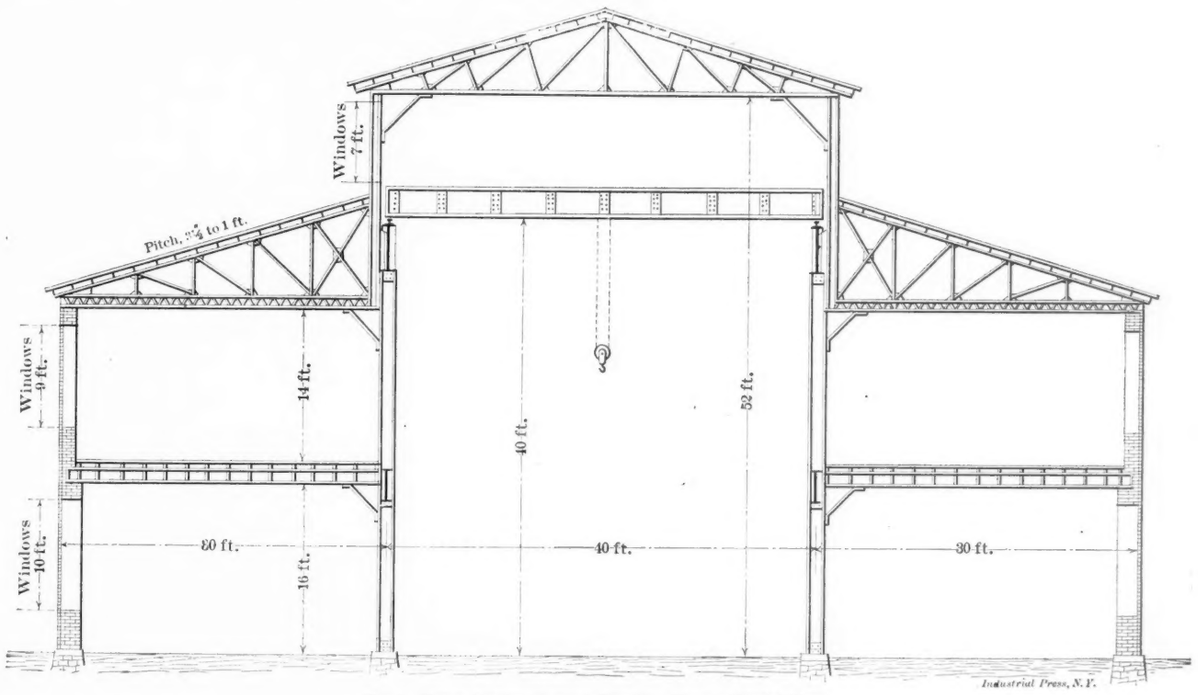


Fig. 1. Cross Section through Machine Shop of Model Plant.

The roof* proper should be supported by trusses at each division or bay, and connected by purlins, all securely braced; by which construction lightness, combined with great strength and ample elasticity is secured. For a covering, wood may be used and covered with roofing tin and always protected by a good coating of mineral paint. The covering may be of corrugated iron, although this has the very serious objection of moisture condensing on its underside and dripping into the interior of the building. This may be wholly prevented by laying on a couple of thicknesses of tar paper, or other paper impervious to water, and as a protection against fire from the underside of the tar paper, first laying two thicknesses of asbestos paper. These four layers of paper are supported by galvanized wire netting, tightly stretched over the purlin supports. This is probably the best form of roof

* The roof designs shown are substantially those adopted by the Berlin Construction Co., New Britain, Conn.—EDITOR.

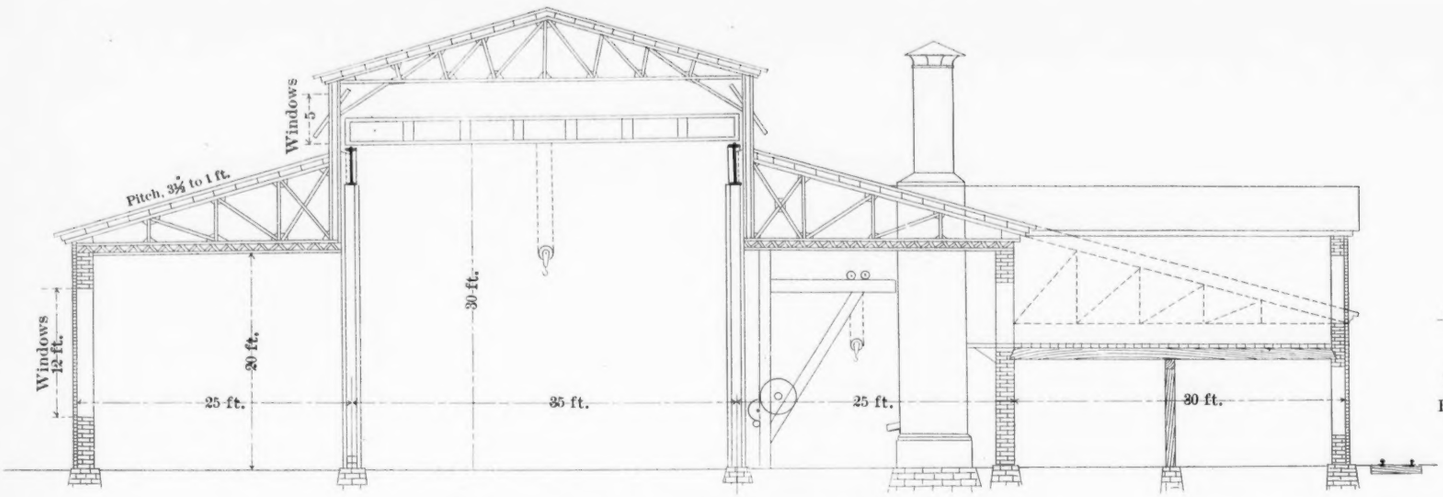


Fig. 2. Cross Section through Foundry, Cupola Platform, etc.

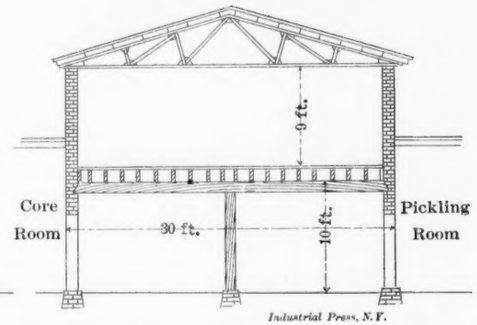


Fig. 3. Section through Cupola Platform at Right Angles to Fig. 2.

covering yet devised for the roofs of manufacturing buildings, and with brick walls, truss roof and covering as described the building is practically fireproof.

Referring to Fig. 1, the machine shop is seen to be constructed with a central portion 40 feet wide and covered by a traveling crane, giving a clear height of 40 feet beneath it. This crane is supported by wide plate girders resting on the main columns, and runs the entire length of the machine shop. It may be operated by belting and gearing, but preferably by electricity, as the necessary power is much more readily transmitted to any point in the length of the building by conducting wires and a suitable trolley than by means of shafts and belts with their attendant expense and annoyance.

On each side of the central portion of the building are wings 30 feet wide, extending the whole length of the structure, and built in two floors, the upper one, or gallery, being used for light machinery. It extends across the front end, both as a means of conveniently connecting the two galleries and of affording a platform for transferring to and from the ground floor by the traveling crane.

The lower member of the roof truss is of latticed form, to give the required strength for supporting the lines of shafting. The floors of the galleries are supported by girders, upon which floor joists are supported, and to the under side of which the line-shaft hangers are attached.

The side walls are built 20 inches thick for the first story, or 16 feet, and 16 inches thick for the remainder of the height, and are strengthened by buttresses 8 inches projection and 24 inches wide. Each bay, or division, is 18 feet 3 inches centers, and the side wall is pierced for two windows on each floor, each window being 4 feet wide; the lower ones 10 feet, and the upper ones 9 feet high. Above the wing roofs is another series of windows 5 feet high, extending the entire length of the building and separated one from the other only by about 12 inches, thus giving ample light to the central portion of the building. Every alternate sash is pivoted so as to be opened for ventilation.

The roof is constructed as has already been described, with an outward covering of corrugated iron, and has a pitch of 3½ inches to the foot, as have the roofs of all the buildings of the plant. The form of truss is the usual one, as shown in the engravings.

The foundry is built on a plan similar to that of the machine shop, with a central part 35 feet wide and side wings 25 feet wide each. On the cupola side the wing proper is extended 30 feet further, to furnish accommodations for the cupola platform, chipping, core and flask rooms. See Figs. 2 and 3.

The central part of the foundry is covered by a traveling crane supported by plate girders resting on the main columns and having a clear space of 30 feet beneath it, while the side wings are 20 feet in the clear. The operations of the foundry do not require this height, but it is very desirable to have ample space for the steam and gases, incident to "shaking out" the flasks after pouring off. To further facilitate their exit the upper windows 5 feet in height, opening over the roofs of the side wings are all made with pivoted sashes, so as to be readily opened when necessary.

The bays or divisions between columns are 18 feet 6 inches centers. The side walls are 20 inches thick, strengthened by buttresses of 4 inches projection and 18 inches wide, and each bay is provided with two windows 4 feet wide and 12 feet high, affording ample light to the side wings and, by the aid of the ventilator windows, completely lighting the whole interior. The lower member of the roof trusses for the side wings is of latticed form to afford sufficient strength for supporting the cranes, and for trolley hoists at any point needed.

The cupola platform construction is shown in cross-section in Fig. 2 and at right angles with this in Fig. 3. A floor supported by suitable timbers forms the cupola platform proper. This may be constructed entirely of iron, if desired, in order to lessen the liability to damage by fire. The platform should be covered with sheet iron, at least in the immediate vicinity of the cupolas, and should be placed at a proper height to suit the cupolas used. It may be reached by way of an elevator carrying one of the yard tram cars, as will be described hereafter in another article.

The forge shop is built much heavier in proportion to its size than the other buildings, on account of the strains and shocks caused by heavy hammers and drop presses. It is 50 feet wide, 80 feet long and 18 feet high in the clear, and no columns or other obstructions interfere with the free working. The roof girders are strongly built and thoroughly braced, and the lower member made in latticed form for supporting the usual overhead work of the shop. See Fig. 7.

The walls are 20 inches thick and 18 feet high, strengthened by buttresses 8 inches thick for a height of 8 feet and 4

inches the remainder by 20 inches wide. The spaces or bays are 13 feet centers and the wall is pierced for one window to each space. The windows are 4 feet wide and 12 feet high, and located, five on each side, three in the front and one in the rear, making fourteen in all.

The roof ventilator is 12 feet wide and extends the entire length of the building, with openings 4½ feet high, as in Fig. 4.

Along the outer wall are arranged chimneys for six forges. If the system of downward draft is employed these would not be needed, the smoke and gases from all being carried to one chimney conveniently located for that purpose. In consequence of the arrangement necessary for these chimneys, when such construction must be used, the buttresses on this side are placed opposite the chimneys and the windows between. This necessitates the use of a steel I-beam in the wall over the windows for supporting the roof trusses. By reducing the number of chimneys to five, this may be avoided.

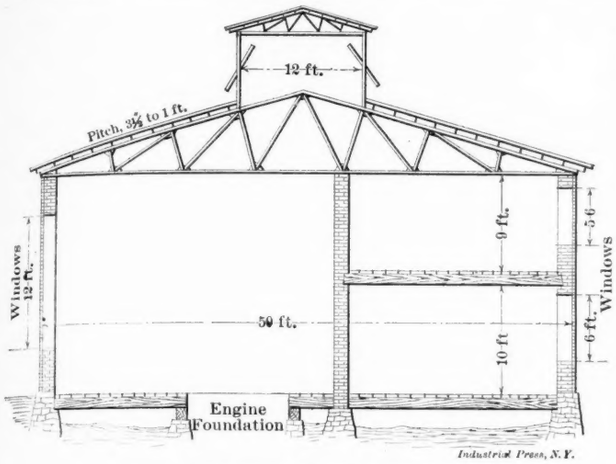


Fig. 4. Cross Section through Power House.

The power house is of construction similar to the other buildings. The walls are 16 inches thick and 20 feet high, with buttresses 4 inches thick and 20 inches wide. 12-inch walls divide the boiler room, engine room, water closets and wash rooms from one another, the last two being built in two floors—the lower one 10 feet and the upper 9 feet high, in the clear. There is a ventilator 12 feet wide, running the whole length of the building, with pivoted windows on each side, 5 feet high, shown in Fig. 4.

When the power required would render it necessary the entire building might be devoted to the boiler and engine rooms, and the wash rooms and water closets be provided for in a side addition. They are placed as shown in order to secure a central location and immediate connection with the machine shop without encroaching on its space. Plenty of light is provided for the wash rooms and water closets by rows of ten windows, 3 feet wide, on each floor, the upper ones being 5½ feet and the lower ones 6 feet high.

The engine room and also the boiler room are lighted by four windows, 4 feet wide and 12 feet high, in the outer wall; while two extra windows are placed in the end of the boiler room for the purpose of giving extra light in the rear of the boilers. In the end of the boiler room is a double door 12 feet wide, one-half of which only need be opened to admit the coal car. Near this door are the track scales for weighing the coal as it is brought in. The tram track is continued the length of the boiler room, in front of the boilers and through the door into the engine room, as a convenient means of bringing in or taking out any small machines such as dynamos or similar apparatus.

The engine room connects with the machine shop by an opening 14 feet wide and 16 feet high, through which engines or large pieces of machinery may be moved, and through which main belts may be run. This space may be closed up, after the power plant is installed, either by doors or by a wooden partition containing suitable doors.

The storehouse for finished machinery, and the carpenter shop adjoining, Fig. 5, are of the same general construction as the other buildings, so far as the walls and roofs are concerned. Both have 16-inch walls, 14 feet high for the carpenter shop and 18 feet for the storehouse, and strengthened by buttresses of 4 inches' projection by 16 inches' width.

The storehouse floor is 3 feet above the level of the machine shop floor. Near the back wall (next to the railway track) the floor is cut out and a specially constructed tram car traverses the space, the top being on a level with the floor. This car track crosses the machine shop floor, and passes over the scales located in it, directly under the traveling crane. By this arrangement machines may be transferred from any point in the shop to this car, standing on the scales, and may be weighed, run into the storehouse and stored away or conveniently run into a car on the railway track, the top of the cars being also on a level with the storehouse floor.

In case the machinery built is of sufficient weight to make such an arrangement desirable, the lower member of the roof trusses should be of latticed form, or, if needed, several of them may be plate girders, in which may run trolley hoists for lifting a machine from the tram car and running it back into the rear of the storehouse or out upon a railway car. The girders may project out over the railway tracks sufficiently to permit of easy handling in loading cars.

Two sliding doors, one of 8 feet and the other of 12 feet in width and both 12 feet high, are provided for shipping convenience. The storehouse is lighted by eleven windows, each 4 feet wide and 10 feet high. Additional windows might be located in the rear wall, over the storage sheds and in the end toward the forge shop if the machinery manufactured was of such small size and such variety as to make a division of the storehouse necessary to properly store and care for it.

The carpenter shop is provided with a sliding door, 6 feet wide in the side, where a branch of the tram tracks enters, and one in each end 10 feet wide. The shop is lighted by thirteen windows, 3½ feet wide and 6 feet high. The roof trusses are placed 15 feet from center to center, the lower members being latticed to afford support for the shafting driving the wood-working machinery. See Fig. 5.

The storage sheds for coal, sand, coke, etc., as well as those for cast iron, steel chips and similar materials, may be built of wood, but a brick construction will be found to be much more satisfactory.

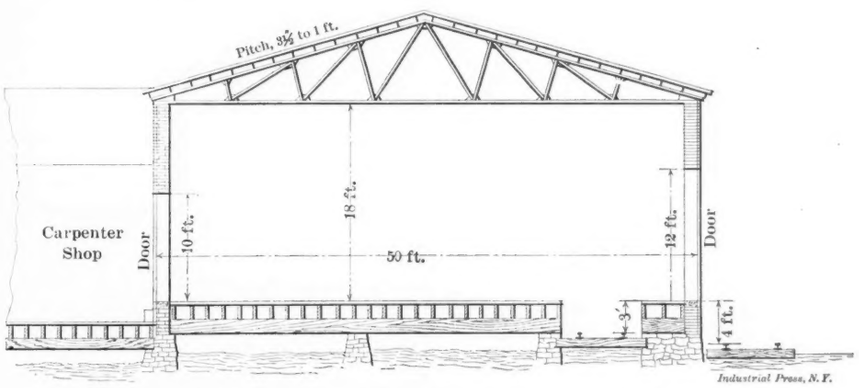


Fig. 5. Cross Section through Store House, Carpenter Shop, Tracks, etc.

The walls should be 12 inches thick and 8 feet high on the side next to the yard. The roof may be what is termed a "gravel roof;" that is, consisting of wooden rafters covered with one-inch rough boards, over which is placed tarred paper, then a coating of well-boiled gas tar, and upon this a layer of gravel stones of from ⅛ inch to ⅜ inch diameter and perfectly free from dirt. This roof should have an inclination of one inch to one foot, although slightly less is often used.

For the coal and sand sheds the openings in the walls may be 3 feet high, beginning just under the roof, and 6 feet wide, on the side next to the railway track. These should be closed by hinged doors of two thicknesses of ⅞-inch boards, the grain of each thickness crossing the other at an angle of 45 degrees.

On the side of these sheds, next to the yard, sliding doors, hung from the top and usually not over 10 feet wide, are most practical. To be substantial they should be made as described above, of two thicknesses of ⅞-inch boards.

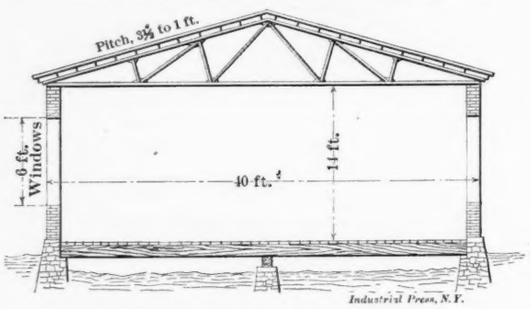


Fig. 6. Cross Section through Carpenter Shop.

Inside of these and about a foot from them planks 12 inches wide and from 2 to 3 inches thick should be set on edge, to sustain the weight of material behind them. These should be fitted in grooves at the ends so as to be easily removable, as occasion may require, and they may have a central support of a scantling set in a hole in the floor and properly supported at the top.

The floors of these sheds may be of 2-inch planks, supported by scantling 4 x 4 inches, laid 18 inches from center to center. But much better than this, and cheaper in course of time, will be brick paving, laid as will be described in a future article on floors.

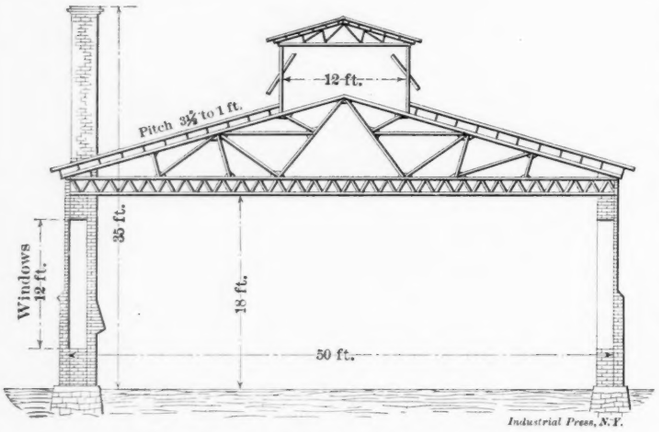


Fig. 7. Cross Section through Forge Shop.

The construction of the shed in the rear of the forge shop should be as described above, except that there will be wood floors for the wash room and water closets.

The questions of foundations and floors have been here omitted and will form the subject of another article of this series, wherein will be considered various forms of floors, both of wood and other materials, and wherein some of the reasons for the failure of many of them now in use will be pointed out.

* * *

The accurate determination of high temperatures involves the use of expensive and delicate instruments, known as pyrometers. For determination of muffle temperatures the following observations made by Violle will give very approximate results: Fireclay just glowing in the dark is at a temperature of about 525 deg. C.; dark red, 700 deg.; cherry red, 900 deg.; bright cherry, 1,000 deg.; orange, 1,150 deg.; white, 1,300 deg. To convert degrees centigrade into degrees Fahrenheit multiply by nine, divide by five and add thirty-two: Thus, 1,000 deg. C. equals 1,832 deg. F.—*Mining Reporter.*

STEEL AND ITS TREATMENT.—3.

ANNEALING.

E. R. MARKHAM.

According to the generally accepted definition of the term the object of annealing steel is to soften it, so that it may be machined at the minimum cost of labor and tools. Steel is annealed by heating red hot, and cooling *slowly*. The greater the amount of time consumed in the cooling operation the softer the steel will be—everything being equal.

The method pursued when annealing steel depends, as a rule, on the facilities which the shop possesses for doing the work. A piece of steel may be softened somewhat by heating red hot and laying to one side to cool in the air. It must not, however, be placed on any substance that will chill it, nor where any current of air can strike it, or it will cool too quickly to become softened; in fact, it will very likely be harder than if worked without attempting to anneal it.

The young hardener should understand that a piece of steel is hardened by heating red hot and cooling *quickly;* the more rapid the process of cooling the harder the steel will be. With annealing the process is just the opposite; the steel is heated red hot and allowed to cool *slowly*, and the slower the cooling operation the softer the steel will be. Now it is evident that if a piece of steel be heated to a red and laid on an anvil or other piece of cold metal, or thrown on the floor, the portion lying on the cold substance will chill, and the process of hardening, instead of annealing, takes place. The same is true if the piece be placed where a current of air can strike it, even if it is warm air; for it will be cooler than the steel, and the heat in the steel will be taken up by the air.

It is the custom in many shops to anneal steel by heating and putting in a box of ashes or lime. Now this may or may not be advisable, according to the condition of the contents of the annealing box. If the room in which the box is kept is damp, the ashes or the lime—especially the lime—will absorb enough moisture to chill a piece of red hot steel, particularly if it be a small or thin piece. When steel is to be annealed by this process heat a piece of iron or scrap steel and bury it in the ashes or lime, leaving it there until the piece to be annealed is properly heated. Then remove and put the piece to be annealed in its place. The ashes or lime being hot and every trace of moisture removed the process of cooling will be slow, and the results satisfactory. A box of lime furnishes an excellent means of annealing steel, if the precaution mentioned is observed.

A very satisfactory method of annealing, which has been used by the writer many times, where there were only one or two pieces to anneal at a time, is as follows: Take an iron box; put two or three inches of ashes in the bottom. On this lay a piece of board a trifle larger than the work. Heat the pieces to the proper degree, lay them on the board, put another piece of board on top of them and fill the box with ashes. The pieces of board will smoulder and keep the steel hot for a long time. The process of cooling will be very slow.

There is a method of annealing practised in some shops which, while it has many advocates, can be recommended by the writer only as a means of annealing a piece of steel that is wanted for immediate use. It is known as cold water annealing. The steel is heated to a red and allowed to cool in the air where no current of air can strike it. It is held in a dark place, and when every trace of red has disappeared it is plunged into water and left until cold. The steel will be softer if plunged into soapy water or oil. This answers in an emergency, but owing to the liability of the ends cooling faster than the center, and the smaller portions cooling more rapidly than the larger ones, it is evident that the steel when chilled must be of an uneven temperature throughout.

The method used in many shops of heating a piece of steel in a furnace using gas, oil or gasolene as fuel, to the proper annealing heat, then shutting off the supply and allowing the work to cool down with the furnace, is attended with varying results. While many mechanics advocate this method and claim excellent results, and while it has been used by the writer to his satisfaction, yet quite a number of cases

have come to his notice of late where persons had annealed in this way with results that were far from satisfactory. An investigation showed that in heating the steel the furnace had been forced in order to heat the piece quickly. As the steel was heated by radiation it was necessary that the walls of the furnace or the muffler should be hotter than the piece of steel being heated. When the steel had apparently reached the proper heat the supply of fuel was shut off; but the inside walls of the furnace being much hotter than the work, imparted heat to the steel after the fire was put out, with the result that the steel was overheated and injured, and in some cases entirely unfitted for use.

A steel maker of national reputation says that "many thousands of dollars' worth of steel are ruined annually in this way, and it is in every way about the worst method of annealing that was ever devised." Consequently the writer feels it his duty to condemn in no uncertain words a method he had successfully practised under favorable circumstances, because mechanics are not all so favorably circumstanced and do not use sufficient care in heating steel. Very especial care is necessary when it is nearly to the proper heat, but most men insist on forcing it; and this is detrimental to the edges and corners, which will heat faster than the center, and to the whole piece. For if the furnace is hotter than the steel, then when the fire is extinguished the furnace is closed and there is no means of looking into the oven to determine the amount of heat the steel is receiving.

A method of annealing that gives universal satisfaction—when properly used—and that is employed in many shops, consists in packing the steel in iron boxes, filling the spaces between the pieces of steel with powdered charcoal. In this method it is necessary to place one or two inches of charcoal in the bottom of the box before putting in any steel, and the pieces of steel should not come within one-half inch of each other in the box, or within one inch of the box at any point. When the box is nearly full, fill the balance of the space with charcoal, put on the cover and seal with fire-clay. The steel should be kept from coming in contact with the boxes, because iron—especially cast iron—has a great affinity for carbon and will, when the steel and iron are both red hot, extract this carbon from the steel, leaving the steel somewhat decarbonized at the point of contact.

To determine when the contents of the box are heated to the proper degree several ¼-inch holes should be drilled through the center of the cover and a 3-16-inch wire run down through each of these to the bottom of the box. When the work has been in the fire (according to the judgment of the operator) long enough to heat through, draw one of them by means of a pair of long-handled tongs or with a pair of ordinary length, slipping a piece of gas pipe on each leg to give the required length. If the wire shows hot the entire length the operator may rest assured that the steel is of the same temperature, because the wire was run down between the pieces in the center of the box. If the wire does not show red hot he must wait a while then draw another. When a wire is drawn that shows the proper degree of heat the box should be left long enough to insure the steel being heated uniformly throughout; then the fire may be extinguished. If the walls of the furnace are much hotter than the boxes the door may be left open until they are somewhat cooled. If the furnace shows a disposition to heat the boxes too much with the door open the box may be removed for a few minutes until the furnace is somewhat cooled. Then the box may be returned to the furnace, the door closed and the work allowed to cool slowly.

A way to insure excellent results is to plan to empty one furnace of work to be hardened some little time before the work being annealed is sufficiently heated. Keep the first oven closed to retain the heat as much as possible; but it will pass the stage where it is liable to overheat the articles and will commence to cool down somewhat. When the work has been subjected to the heat for a sufficient length of time the boxes may be removed from the oven they were heated in and placed in the first oven. All danger of overheating from radiation is then done away with. This cannot, of course, be practised where there is but *one* furnace.

While it is generally understood that the object of annealing steel is to make it soft enough to work to advantage, yet from the hardener's standpoint annealing has another and more important office than simply to make steel workable. A piece of steel as it comes from the steel mill or forge shop is very apt to show a difference of grain in its various parts, due to uneven heating and unequal closing of the pores from the process of rolling or hammering. Consequently there exist internal strains in the piece. To overcome the effects of these internal strains, which must manifest themselves when the steel is hardened, the work should be blocked out somewhere near the shape and annealed. If the piece is a milling machine cutter, punch press die or similar tool, having one or more holes through it, the holes should be made, but somewhat smaller than finish size, before annealing to remove strains. If it is a milling machine cutter of irregular contour it should be blocked out as represented in Fig. 1. The finished cutter is shown in Fig. 2. The benefit gained in pursuing this course is that, so far as shape is concerned, it is heated for annealing under—as nearly as possible—the same conditions as when heated for hardening. Consequently the tendency to change shape will be overcome in the annealing.

Long pieces of steel to be hardened will give much better results if roughed out. Remove all scale or outside surface by turning or planing, then thoroughly anneal. Should the piece spring when annealing do not straighten it cold, as it is almost sure to spring when hardened. If it is not sufficiently large to turn out without straightening, it should be heated red hot and then straightened.

The hardener is blamed many times because a costly reamer, broach or similar tool is crooked in hardening when in reality the blame rests with the man who turned it or planed it to size. After it is annealed he tests it in the lathe, and, finding

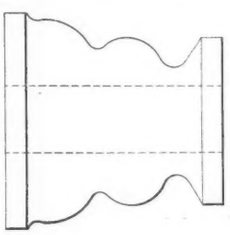
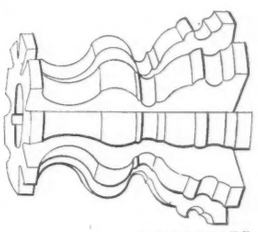


Fig. 1.



Industrial Press, N.Y.

Fig. 2.

it running out somewhat, he takes it to an iron block or an anvil and commences to hammer it. He finally gets it to running very nicely and feels quite proud of his job. He doesn't like to see a man turn or plane a piece of steel which runs out even if it will finish out, when a few strokes of a hammer will "fix it all right." But by means of the hammering he has set up a system of internal strain much more serious than the one removed by the process of annealing. He now commences to machine the piece; every time he goes below the effects of a hammer mark the piece goes in some direction at this point, and it is necessary to repeat the operation of "hammer persuasion" again, with the result that by the time the article is ready to harden it is in no condition to be hardened. It is either crooked in all directions, or it is only waiting for the fire to relieve it and allow it to go where it will.

When the hardener gets through with it, it looks like a "cow's horn." And, of course, the hardener is to blame. If he happens to be a man without machine shop experience or does not understand the nature and peculiarities of steel he does not know where to place the blame—and perhaps it would do no good if he did. But he, of course, is not going to shoulder it; so the fault is laid to the steel. Consequently, if the trouble continues, another make of steel is bought, because the men in charge do not know or cannot spend the time to locate the trouble. "It cannot be the fault with the men in the shop," they say. "It *must* be the steel." Or, again, they decide it must be the hardener, because some other concern with whom they are acquainted use this same steel and have no trouble. So the hardener, poor fellow, must bear the brunt.

A successful business man is quoted as saying: "If I were to drive a mule team I would study the nature of mules." To

be a successful hardener a man must study the nature of steel; he must know what steel is liable to do under certain conditions, and how to avoid undesirable results, no matter whether it relates to his department or some other department. He should know that it is possible for the toolmaker to so treat steel that results anything but satisfactory *must* follow when it is hardened; that he may make the steel unfit for use by overheating when annealing or by not heating uniformly throughout when annealing. If a satisfactory steel is furnished the hardener should never blame the steel for bad results caused by his ignorance or carelessness. The next time he may be furnished with an undesirable steel, and after a while those over him in authority will tire of complaints about a steel that another concern is satisfied with.

In some shops they pack the article in a box with cast iron dust or chips. Now this method works nicely when annealing forgings or other pieces of *machinery steel* which were hard and showed glassy spots and could not be softened by the ordinary processes of annealing. The cast iron seems to have an affinity for the impurities liable to be present, and the result is very soft, easily-worked pieces. But if this method is applied to *tool steel* the carbon, as we stated before, is extracted to an extent that is highly injurious to the steel. To be sure, tool steel can be annealed very soft if packed as described, but the results are anything but desirable.

Another way to anneal machinery steel is to pack the pieces in the annealing box in expended bone—that is, bone that has been previously used in casehardening. This is also an excellent way of packing cast iron that requires annealing, such as small castings for typewriter parts, etc., which must be very soft in order to machine nicely. But tool steel should never be packed in any form of bone, as bone contains phosphorus, which is the most injurious of any of the impurities tool steel may contain. The steel maker uses every effort possible to reduce the percentage of this impurity to the lowest point; for, while it is a hardening agent, its presence makes tool steel brittle. And it is folly to pay a high price for steel which the manufacturer has spent much care in ridding of undesirable impurities and then to use a method whereby the steel will be charged with these very impurities.

In conclusion, it may not be amiss to emphasize a few facts that have already been mentioned. Do not overheat steel when annealing, or it will be *permanently* injured. Do not subject it to heat for a longer period of time after it becomes uniformly heated throughout than is necessary to accomplish the desired result. For while it is essential, when annealing, to heat to as high a temperature as for hardening and for a period of time that insures its being of the same temperature in the middle of the piece as it is at the surface, yet care must be taken not to overdo it. Steel kept at a red heat for a long time, even if not overheated, will betray the fact when the temper is drawn, if not before. It may to all appearances harden all right, but when the temper is drawn the hardness apparently "runs out." For instance, when the piece is heated to a straw color it can be filed very readily; whereas a piece from the same bar not annealed, or that has been annealed properly, then hardened and drawn to the same temper color, would show all right; that is, a file would just catch it.

Uniform heating when heating for annealing is as desirable as when heating for hardening. If in a large block the corners and edges are hotter than the main part violent strains are set up at these points. It is therefore readily apparent that uniform heating is one of the secrets of successful handling of tool steel.

Lastly, remember that any process of annealing which takes from the steel any of its hardening properties is not fit to use, no matter how soft it may make the steel. It is better to work a piece of steel which is hard than to unfit it for doing its maximum amount of duty when finished. But it is possible to anneal most steels so that they will be workable and yet harden in a satisfactory manner; in fact, in a much more satisfactory manner than if not annealed.

The writer wishes it understood that these articles deal entirely with *carbon steels*, and not with the so-called self-hardening steels. These are very valuable, but are not under consideration at this time.

NEW WORKS OF THE B. F. STURTEVANT CO.

GENERAL FEATURES OF THE PLANT AND THE CONSIDERATIONS WHICH LED TO THEIR ADOPTION.

The new works of the B. F. Sturtevant Co., now nearing completion at Hyde Park, Mass., present an excellent opportunity to study the factors that control in the location and design of a modern manufacturing plant. The present plant at Jamaica Plain, Mass., is too small for the business and has no room for growth. A fire, which nearly destroyed the whole plant a year ago, forced an immediate selection and a site of 20 acres was procured at Hyde Park, Mass., six miles from the present location, the home of several prominent machine works. In deciding upon the new location, the claims of the West were weighed against those of the East, but an abiding faith in the future prosperity of New England and the fact that a large number of skilled mechanics are available in the vicinity of Boston, won out in the end, in spite of the somewhat higher rates for raw material in the East. The lot selected has a frontage of 1,300 feet on the N. Y., N. H. & H. R. R., and one side is bounded by a large brook, which will supply water, and there is ample space for dumping waste material.

In laying plans for the buildings, the head of each department was consulted, his recommendations reduced to writing, and frequent conferences were held. With these data at hand the plans were started with the idea of providing a total floor space slightly more than double that of the present plant. The lay of the land and its available area being somewhat against a group of one story buildings, and a simple calculation showing that the actual cost of the power expended in a single year for lifting the entire product of the works through a distance of 20 feet figured only a very small sum, determined the company upon the erection of multi-storied buildings. The character of their products readily lent itself to such a design, and it was believed that the expense in going from floor to floor would be more than offset by a reduction in the horizontal distances necessary to be traversed.

The arrangement of the buildings was determined by the provision to be made for growth. One arrangement of a series of parallel buildings permitted increase only by multiplication of buildings, but provided an excellent opportunity for the carrying of switch tracks across both ends of each building. The other arrangement provided for a group of buildings parallel to the railroad tracks, with accommodation for switch tracks between buildings, and for their entrance at the ends of the building, with an opportunity for growth by extension in length, and this was the plan adopted.

For the construction of the buildings the latest all-steel and concrete type with large window areas did not appear to meet the requirements of the group. All steel buildings, brick walls and concrete fire-proof floors presented disadvantages in the way of discomfort to workmen, inconvenience in attaching machines on hangers, and excessive expense which did not appear to be offset by advantages to be secured in the way of absolutely fire-proof construction. The type finally selected is composite in its character, consisting of steel interior columns and main steel girders, with heavy brick walls, wood timbered floor and plank roofs. In the case of the one-story foundry, the roof is supported by steel trusses; in the other buildings open timbering with wooden columns in the upper floor is employed. The main floor in the machine shop is of tar concrete with spruce and maple flooring. The upper floors are carried upon wooden beams spanning the spaces between the steel girders, which follow a unit system of 20 feet on centers through the building. All roofs are of 3-inch plank with tar and gravel top.

The question of power was early decided to the extent that the entire plant would be electrically driven from a central power house; that the engines would run condensing; that the exhaust steam derived from engines under test, which is considerable, would be utilized for heating, with supplementary amount of live steam admitted at reduced pressure as might be required. The power house was placed sufficiently far from the ends of the buildings to permit extension of each, and near to the water supply.

The pattern building provides at one end a two-story portion 80 feet square for carpenters and flask makers on the first floor, and for pattern makers upon the second floor. The bal-

ance of the building which is devoted to pattern storage is provided with intermediate floors, making four in all, separated from the other portion of the building by double fire walls and automatic fire-closing doors. The close proximity of this building to the foundry facilitates rapid intercourse.

The foundry, 170x350 feet in dimension, is designed with the idea of distributing iron upon a track system, and is to be equipped with narrow gaged railways bedded in concrete, making runways between the moulding floors. Two craneways run lengthwise of the building through the greater part of its length, and the tracks extend beneath the crosswise traveling cranes in the cleaning room at the end of the building. The brass foundry is located in one corner, a wash room in the adjacent corner, a core room between the two; the latter has ample opportunity for growth towards the center of the foundry, while the foundry itself can be extended to practically double its length. Storage for supplies is provided upon one side adjacent to the railroad switch. From the bins thus provided, the iron and fuel charges will be carried directly to the charging floor.

From the foundry the castings will pass to the rear of either the machine shop or the fan shop. The former is of the familiar gallery type, 500 feet long, with wings 40 feet wide, and central runway of the same width for crane of 20 ton capacity. The lighting will be principally by a series of sawtoothed skylights running crosswise of the roof, with glass facing due north. The crane will serve the entire floor and transport heavy castings from the machine tools to the erecting floor. Here the completed engine or generator may be lifted upon a transfer car passing through the testing building, and there picked up by another 20-ton crane which will drop it upon the testing plate and subsequently carry it forward to the steam railway track which passes through the end of the building and provides space for the loading of two cars at a time. The upper floor of this building, together with portions of the adjoining buildings, is devoted to the electrical department and provided with individual small traveling cranes.

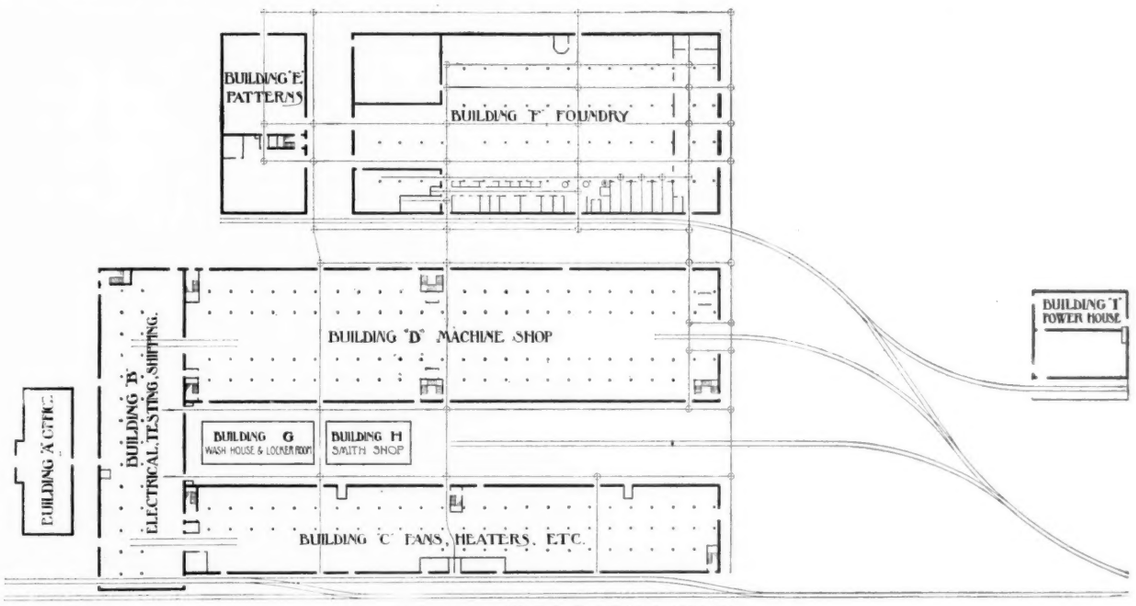
The building devoted to the manufacture of fans, heaters, etc., is 80 feet in width, of the same length as the machine shop (500 feet), is three stories in height, of typical mill construction, with conveniences for handling material and arranged so that shipment can be made from numerous points along one side, while supplies are brought in from the court between it and the machine shop.

The smith shop, 40 feet by 80 feet, serves both buildings with equal facility while the wash house and locker room, measuring 40 feet by 100 feet and three stories in height, is so located as to reduce to a minimum the distance to be traversed by the individual workman. The third floor will be used as a lunch room.

The standard first floor height in the main building is 17 feet, that of the second and third stories is 15 feet. The windows are large and numerous.

The office is to serve as headquarters for the entire business. It will contain the correspondence, designing and drafting offices, the superintendent's quarters, the cost department, the advertising bureau, and a printing office which will be located in the basement. It will be three stories in height with a finished attic to provide additional drafting room space.

The equipment of this plant will be largely "Sturtevant" in its character. Beginning with the power plant, the mechanical draft apparatus, the engines and generators and the exhaust head will be of Sturtevant make. The buildings will be heated by the Sturtevant system; the shafting and individual machines driven by motors of the same make; the removal of refuse from the wood working machinery, the dust from the foundry cleaning room, the ventilation of the offices, toilet rooms, and wash house, and the removal of smoke from the smith shop will be accomplished by Sturtevant exhaust fans. Sturtevant blowers will be used for brass and iron foundry, forge shop blast and the like, and Sturtevant steam traps will be employed upon the steam drivers.


BUILDING 'E' PATTERNS
BUILDING 'F' FOUNDRY
BUILDING 'D' MACHINE SHOP
BUILDING 'T' POWER HOUSE
BUILDING 'A' OFFICE
BUILDING 'B' ELECTRICAL, TESTING, SHIPPING
BUILDING G WASH HOUSE & LOCKER ROOM
BUILDING H SMITH SHOP
BUILDING 'C' FANS, HEATERS, ETC.

Floor Plan of New B. F. Sturtevant Works.

INSURANCE CANCELED BY AN OWNER BECAUSE HIS BOILER WAS UNSAFE.

"If you don't play in my yard I won't play in yours" indicates a spirit that is not by any means confined to childhood. But it is a little strange that business men should allow such considerations to influence them in so important a matter as steam boiler inspection and insurance, as related in the following extract from *The Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Co.:

We recall a meeting of certain commissioners, held in a town, a little while ago, at which a report was read concerning a stone crusher boiler that was insured by the Hartford company, and which had been recently inspected. The inspector reported that the boiler was in bad shape, and that it would be more economical to buy a new boiler than to make the extensive repairs that would be required to put the old one in good order. The commissioners at once voted to cancel the insurance on the boiler in question. It would appear that when a report of that kind had been received it would be a good time to continue the insurance as long as the insurance company would carry it, or at least until such time as measures could be taken to put things in proper shape; but we cannot pretend to have the combined wisdom of an entire commission, and so we bow as gracefully as possible to the decision. We may add, however, that we never shed any tears of regret when a patron discontinues his insurance on such a boiler as this. We may also add that if the boiler should blow up, the commissioners would stand in an unenviable position, if they do not take immediate proceedings, on their own initiative, to fix the boiler up, or replace it. Ignorance is never a very good excuse, but when one cannot make even that plea he is in a bad way, so far as moral responsibility is concerned.

NOTES OF TRAVEL.

AN ENGLISH SCALE-MAKING FIRM—A SHOP BUILT BY JAMES WATT—RELICS OF THIS NOTED INVENTOR.

Editor MACHINERY:

In a very attractive album issued by W. & T. Avery, Ltd., of Birmingham, England, builders and manufacturers of weighing machines and steam engines on the site of the Soho Foundry of James Watt, the following occupies the only page of reading matter:

A Short History of the Progress of
W. & T. AVERY, LTD.

Birmingham is the center of the weighing machine trade of Great Britain, comparatively little being made elsewhere, and here the business now known all over the world as W. & T. Avery, Ltd., was established in the year 1730. Like many other old businesses it was commenced in quite a small way in Digbeth, one of the most ancient streets of the town. From its inception as a workshop for making steel yards, it gradually grew; other forms of scales and apparatus, including

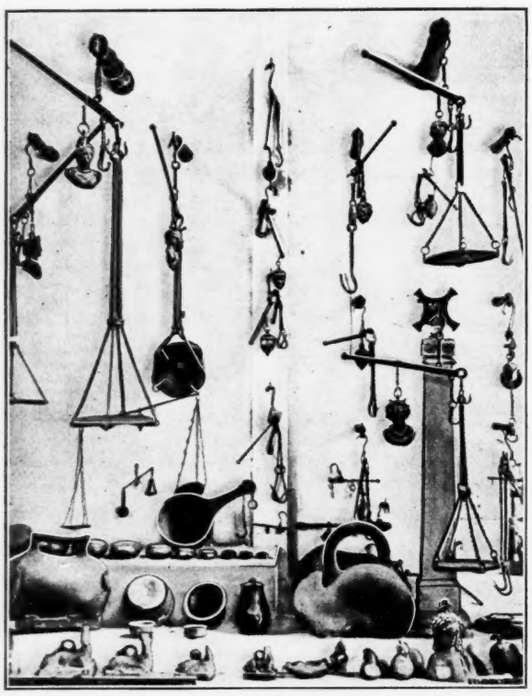


Fig. 1. Weighing Appliances over 2000 years old, found in the Buried City of Pompeii. Highest Weighing Capacity 120 Pounds.

Avery's agate bearings, being added to its list of productions, and the premises continually increased until in the year 1854 Messrs. W. & T. Avery built the first shops of their new factory in Mill Lane, which has in turn continually extended from time to time. In 1868 they purchased the Atlas Works, West Bromwich, where their iron founding was done.

The combined works stood on between 16,000 and 17,000 square yards, most of which were covered by shopping three or four stories high, fitted with machinery of all kinds, driven by five engines of various sizes.

In 1891, Messrs. Avery, finding their business still increasing by leaps and bounds, registered it as a private limited company, and in 1894 as a public company under the title of W. & T. Avery, Ltd.

In 1896, the directors considering the works in Mill Lane at West Bromwich too small for their ever-increasing trade, purchased the Soho foundry made world-renowned by the great James Watt. There they erected extensive buildings upon twenty acres of land, and during the following two years concentrated there their different factories. An extensive plant of special machinery was installed in each department, to insure the most accurate and economical results.

The company employ about 2,000 hands, their production ranging from the finest scientific balance weighing "in vacuo" to the greatest locomotive weighbridge capable of indicating a load up to 180 tons.

The great engineering business of James Watt & Co. is still carried on under the aegis of W. & T. Avery, Ltd.

Messrs. Avery have opened branch works in London, where chemical, assay and other fine balances are made; and in Glasgow where weighbridges are constructed for the Scotch and Irish markets. They have also branches in the principal towns of the United Kingdom.

An inspection of the works under the guidance of the manager convinces one that in the main, the establishment is very much up to date, measured by the gage of an American engineer and manufacturer. The few points in which there is room for modernizing are well known to the manager and he avers that improvements thereon are under consideration. The chief desideratum is quick-acting and powerful hoisting and conveying appliances. The traveling power cranes that are now in use are driven by either one or the other of the power-devouring agencies—the flying rope or the square shaft. Several of the cranes are hand driven.

The old shops of the engineering department, built and used by James Watt, form a striking contrast with the other buildings, well lighted and fully equipped with the appliances of heating and ventilating.

Only a small portion of the engineering department's work is done in these old shops, which are but a small part of the buildings. A few of the tools of this department are very old but are retained on account of being very useful at times. One of a design unknown in modern machine tools, is a wall planer. The guides along which the cutting-tool carrying the head travels can be seen in the view of "the present erecting bay" attached to the wall just beyond the faceplate of the large engine lathe in the right hand foreground of the cut, Fig. 10. The cutting stroke of the tool is parallel to the wall. It can readily be seen that such a tool would be of little service in any locality where there are great temperature changes acting on the wall and its foundations. It is a better machine for England than for the States.

The heavy scales for weighing horses, cattle, wagons, etc., differ from those of the States in having every part made of metal. No wood is used for any part, be it beam, girder, platform, or casing for the recording parts.

Fig. 2. In contrast to Fig. 1 is this Weighbridge, being Tested to its Full Capacity, at the Works of W. & T. Avery, Ltd.

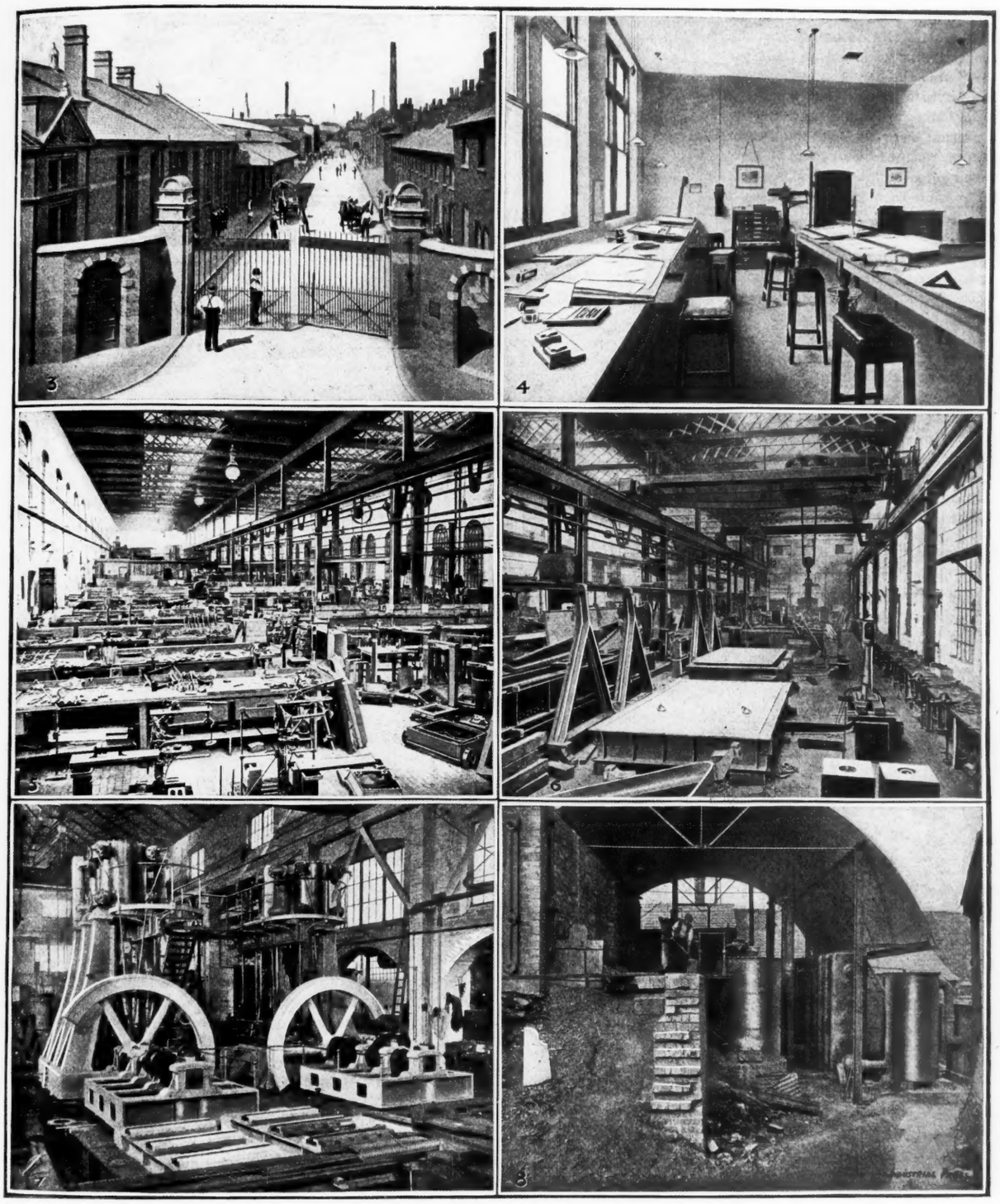
In the heavy balances of the type used by chemists and assayers, the beam is made of welded scrap in order to secure the greatest toughness. Such balances are used for weighing articles of considerable weight in England, such as bales of cotton, crates, heavy boxes, etc., a use to which this type is not applied in the States.

Continuous weighing and recording machines for grain, coal, ore, etc., are an important part of the product.

The heating of the air for warming the shops is done by a method not common in the States where steam coils are used generally. At Avery's the air is drawn through a large furnace, chiefly of brickwork, located entirely outside of the buildings. The heated air is distributed in each building by

metallic pipes with openings and short lengths of pipe on the upper side, so that the air is forced out toward the ceiling or upper region of the space to be heated. This is the reverse of the common practice in the States for heating large shop rooms, which is to carry the air down through branch pipes or outlets from the main, and blow it out toward the floor.

framework for supporting the wheels, each vertical set of wheels is supported by an individual column of its own. The lower part of the column is of heavy masonry, capped by a comparatively short openwork casting. Each column is self-sustaining. A rod or pipe extends up through the middle of the tank also for the purpose of guiding and sustaining it.



VIEWS IN THE WORKS OF W. & T. AVERY, LTD., BIRMINGHAM, ENGLAND.

Fig. 3. Main Entrance.
Fig. 4. Drawing Office.
Fig. 5. Platform Weighing Machine Department. Fitting and Erecting Bay, 300 x 70 feet.
Fig. 6. Weighbridge Department. No. 3 Bay, 200 x 30 feet.
Fig. 7. James Watt & Co. Showing a Pair of Triple Expansion Pumping Engines in course of Erection. Supplied to the Birmingham Canal Navigation in 1899.
Fig. 8. Gas Making. At the rear of this apparatus James Watt erected a gas plant.

A gas reservoir or tank installed by Watt is still in active service. It differs only slightly from those in common use to-day. The chief difference is in the supports of guiding wheels for holding the inverted cup-shaped tank in position and for keeping it from toppling over. Instead of a connected

A line of pipe led from the tank to Watt's residence, a mile or so away on a neighboring hill. His house is supposed by the Averys to be the first residence ever lighted by gas. The tank is in the rear of the gas-making part of the plant shown in Fig. 8.

James Watt Relics.

In two small rooms of the Tangye Co., of Birmingham, England, is a collection most interesting to the engineer. It consists of a lot of letters, account books, records, models, drawings, etc., that were the property of the Watt & Boulton Co. during its existence. They were purchased by the Tangye Co. at a sale of the goods of the old Watt & Boulton Co. The rooms are kept closed for the most part, and the material is not arranged in any way, but stored in boxes, drawers and cases in the condition in which it was when it first reached the rooms.

During a couple of hours spent in looking through these relics a number of interesting things were found.

The reason for Watt's inventing and adopting the "sun and planet wheels" seems made clear in some of the letters. It appears that Watt invented the (now) common crank mechanism for transforming reciprocating into rotary motion. As has often happened, however, some one else learned of Watt's invention and immediately had it patented. An enormous price was then asked of Watt & Boulton for the grant to use the device on their engines. The price was prohibitory, so Watt invented the sun and planet gears by means of which each double stroke of the piston, acting through a beam and connecting rod to the lower end of which one of the gears is rigidly attached, gives the main shaft of the engine two revolutions instead of one, as is obtained with the ordinary crank, connecting rod and beam. It might be added that the second gear is on the main shaft of the engine. Both gears are of the same diameter. A link or arm, much resembling a crank, but free to rotate about the main shaft, holds the connecting rod gear into mesh with the main shaft gear.

It seems certain that the sun and planet gears were not adopted by Watt & Boulton for mechanical reasons, but for monetary ones with possibly a touch of feeling against the patentee of the crank mechanism.

In a letter by Boulton to Watt he inquires whether his understanding of the use of the flywheel is correct. He then sets forth for Watt's perusal an example of how to determine the size of "fly" required for an engine. He first assumes that a man can do a certain amount of work in lifting coal from a mine by means of a windlass—so many pounds an hour lifted a certain height. Then, that if several men work at the same rate to speed up a "fly," putting a given number of man-minutes work into doing it, it will take an equivalent number of man-seconds work resisting the "fly" to stop it. He gives the final result in the words, "then it will take 32 men one second to stop the fly."

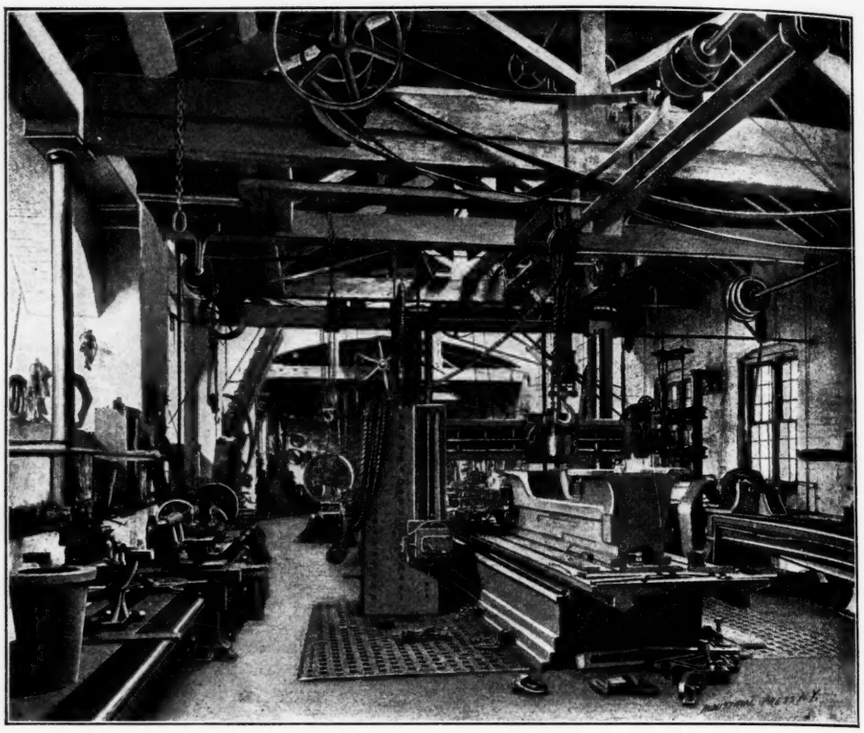


Fig. 9. Engineering Department James Watt & Co. Showing Fitting Shop, 208 ft. x 25 ft., built by James Watt and still in occupation.

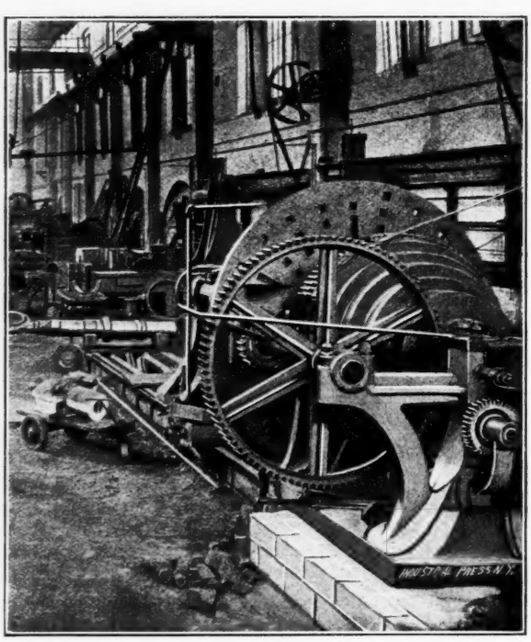


Fig. 10. James Watt & Co. The present Erecting Bay. A Wall Planer shown back of the Lathe was erected by James Watt.

In another letter to Watt, written just after an audience with the King and Queen for the purpose of demonstrating the operation of a letter-copying press invented by Watt, Boulton explains how he found their majesties taking coffee at 5 o'clock, was very graciously received, and kept at full conversation till half past seven. During this time he "made a very good copy of a letter written on a large sheet of paper." The King knew very well about Watt and his works and made many inquiries regarding him, despite the fact that Watt had insisted the King knew nothing of him. Boulton further tells Watt that he gave them both a very fine description of him and his works.

Models of the letter-copying press are in the rooms. They are of the roller-platen type. A felt-covered plate passes under the roll which exerts a pressure. The letter and impression paper are placed on the plate so that the pressure makes the copy. It seems that Watt was the inventor of the letter-copying process and of the ink used for the purpose.

A framed copy of "letters patent" hangs on the wall. The great seal of England is attached by a thong and suspended below. It is a piece of wax 5⅝ inches in diameter and about ¾ of an inch thick and the color of beeswax.

FORREST R. JONES.

Oxford, England.

* * *

Thomas Jefferson, the father of the American Patent Office, is said to have given personal attention to every application made for a patent during the years between 1790 and 1792.

WORK IN THE NEW MACHINE SHOP OF WM. CRAMP & SONS CO., PHILADELPHIA.

About two years ago Wm. Cramp & Sons Co., Philadelphia, completed a new machine shop directly across the street from the shipyard on the water front. A recent visit disclosed a very well-equipped shop for the building of marine engines, it being a decided and agreeable contrast to the old machine shops in the shipyard.

The new shop is a large building of brick with a three-gabled roof facing the street. The erecting floor occupies the middle section, and the machine tools are on the sides of the main floor under the galleries. The traveling crane runway over the erecting floor is well up in the roof, giving a clearance of perhaps 60 feet beneath the hooks. The south side of the building has one gallery over the main floor, and the north side has two gallery floors, which, of course, makes this side one story higher than the main section. Stairways are provided at all four corners leading up to the galleries, and four freight elevators, one at each corner. The tool rooms are in the galleries, there being one on each of the gallery floors. Lavatories and closets are provided on all three floors. Beside the traveling cranes over the erecting floor there are traveling cranes beneath both galleries. A bay is built out from the south gallery floor so that large heavy parts may be moved out over the erecting floor where the traveling crane can handle them. This makes the transfer of large parts, between the two floors, that cannot be handled on the freight elevators easy and convenient. The lighting is excellent, and is all that could be desired for machine shop purposes. The Sturtevant system of forced hot air circulation is employed for heating.

The section under the south gallery is given over to heavy machine tools. Here are a heavy 125-inch crankshaft lathe, a large planer for machining engine frames and bed plates, and three large horizontal drilling, milling and boring machines. All the large tools are driven by independent electric motors, but the smaller tools are motor-driven in groups, the lineshaft being divided into, say, three sections in the length of the shop.

At the time of the writer's visit one of the horizontal drilling machines was employed in boring the bolt holes in the flanges of an intermediate shaft for the battleship *New York*. This is a modest chunk of nickel steel, say, 30 feet long and 18 or 20 inches in diameter. The flanges were about 3 feet in diameter, and each one has eight holes for the coupling bolts. The boring was accomplished by first drilling 1½-inch holes and then enlarging them to the required diameter, which was 4¾ inches at the large end, by means of counterbores. The coupling bolts are made with a quick taper and have no

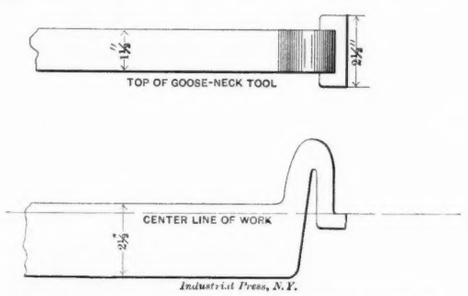


Fig. 1. Tool used in Finishing Nickel Steel Tail Shaft.

heads. The holes were roughly tapered by using three diameters of counterbores through one flange so that the reaming would be somewhat facilitated. The reaming is not done until the shafts are in place on the vessel, where it is done by hand. This means a lot of hard work for three men at the end of a long reamer handle. About ¼ to 5-16-inch stock is allowed to be reamed out.

A nickel steel tailshaft was being finished in a lathe at the time. The finishing cut was taken with a goose-neck tool like that shown in Fig. 1 while deluged with a mixture of turpentine and lard oil.

Marine propellers are usually fitted to their tailshafts by being bored with a tapered hole through the hub and fitted to the tapered end of the tailshaft. Two keys and a large nut on the end of the shaft secure the two parts together. In some cases the keyways are planed parallel with the axis of the shaft. This, of course, makes the keyways deep at one end and shallow at the other. In the Cramp shops a Morton draw-cut shaper has been rigged to plane the keyways parallel with the taper. The shafts are leveled in front of the shaper and the keyways cut from the top. To make the cut parallel with the taper the shaper is mounted on tapered blocks which tilt it backward to the required degree. It may be asked why the shafts are not inclined to the required pitch. Since the tailshafts are about 50 feet long the end away from the machine would have to be depressed 5 or 6 feet, which would require that a hole be dug in the floor or that the shaper be elevated 3 or 4 feet.

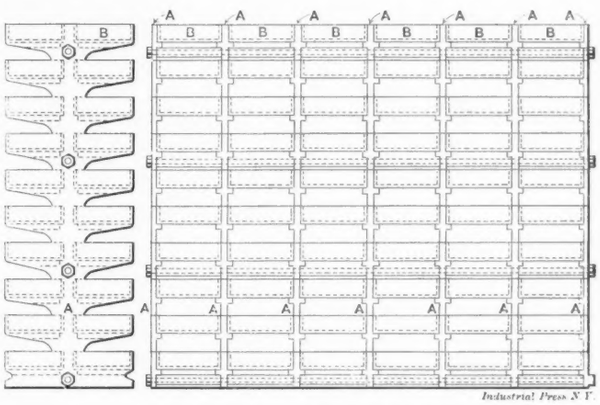


Fig. 2. Tool Room Rack for Trays.

Compressed air is piped to all parts of the shop, and is extensively used for various purposes. On the platen of the large Niles planer was the cast steel bedplate for the engines of a battleship being planed for the feet of the housings. At the same time a workman with a pneumatic hammer was riding back and forth on the platen chipping off the fins and scabs of the casting. Another use of a different character to which compressed air may be put was observed, and that is the cleaning of machines. A compressed air blast is effective in cleaning the dirt and chips from the table of a machine. It leaves the surface practically free from oil and may be used profitably on the frames and other parts that are ordinarily wiped with waste. One bad feature of the practice is that it is likely to cover surrounding objects with grease spattering, unless carefully done.

The tool rooms are provided with racks for trays, on the plan of that shown in end and side views by Fig. 2. They are made of castings like those shown at *A*. These castings are held together by bolts and sections of pipe to act as distance pieces. Ledges cast on the sides support the trays which are made of galvanized sheet iron about 12 inches square and 1½ inches deep. Several racks made on this plan were seen having 13 trays in height on each side and 12 in length, making 312 trays in each rack. The trays are used to hold bolts, screws, rivets, nuts and other small supplies and tools. Being made of iron they do not become oil-soaked as is the case with wood.

* * *

When we speak of the manufacture of iron bolts, nails, rivets, etc., in these days we naturally think that all such work is done, in this country at least, by improved machinery having a large daily productive capacity. Consequently it was with considerable surprise that a shop was recently discovered in Philadelphia, on North 22d Street, working full blast manufacturing carriage bolts and using machinery of the most primitive character, part of which was operated by foot power. The work in progress was forging or upsetting the heads of, say, ⅜-inch bolts. In the machines operated by foot power the hammer was raised after each stroke by a large wooden spring pole attached to the floor overhead. The power-driven machines were of about the same type, the wooden spring pole also being in evidence. The construction of all the machines was of the crudest description and gave evidence of great age. The scene presented seemed quite out of keeping with the present age, it undoubtedly being about as such work was done fifty or sixty years ago.

THE METRIC SYSTEM.

A SUMMARY OF OPINIONS GATHERED BY THE FRANKLIN INSTITUTE, PHILADELPHIA.

While the bill favoring the adoption of the metric system by the various departments of the government was pending before the last session of Congress, a special committee of the Franklin Institute, Philadelphia, had the same subject under consideration. The report of the committee was favorable to the adoption of the system and was as follows:

WHEREAS, It is desirable to obtain an international standard of weights and measures, also to simplify and regulate some of our existing standards; and

WHEREAS, The metric system is commendable not only as a suitable international standard, but also for facility of computation, convenience in memorizing and simplicity of enumeration;

Resolved, That the Franklin Institute approves of any movement which will promote the universal introduction of the metric system with the least confusion and expense.

Resolved, That the National Government should enact such laws as will ensure the adoption of the metric system of weights and measures as the sole standard in its various Departments as rapidly as may be consistent with the public service.

Supplementing the work of the committee the secretary addressed a number of letters to members of the Institute and to others whose opinion on the subject it was thought desirable to obtain. These letters have been published in the last four numbers of the *Journal of the Franklin Institute* and brief extracts from most of them are published herewith, together with quotations from the address of Mr. James Christie, chairman of the committee on the metric system, at the meeting when the subject was discussed; of Mr. George M. Bond, of the Pratt & Whitney Co.; and of Mr. S. M. Vauclain at the same meeting.

In Favor of the System.

In my opinion we need the system and I hope it will become international. We need it because it is the rational system connecting measures of length with those of area, volume, etc. It appears to me that our people have been long enough under the incubus of "long" and "short" tons, "long" and "short" hundredweights, "dry" quarts, "liquid" quarts and the like—units without any rational relation or often with curious fractional relationship to one another.

I may add that I have been in consultation with most of the heads of departments and engineers of the General Electric Co., and find that on the whole they are favorable to the adoption of the metric system, especially on new work, with the idea that it would eventually entirely displace existing measures.—Elihu Thompson (General Electric Co.)

The practical convenience of the workshop must, I believe, give way to the overwhelming theoretical advantages of the metric system. These advantages cannot be successfully disputed, and I have therefore been compelled reluctantly to admit the adoption of the metric system as a wise step for this country to take. Any system is better than none at all, and no system founded on the natural subdivision by 2 would with our present notation be acceptable to the great army of thinkers who plan the work of the world.—Wilfred Lewis.

I have for many years worked with both systems and by practical experience have found the metric system as far superior to our present system (or rather, want of system) as our decimal currency is in advance of the English £, s., d.

When a generation or two hence the history of the present time is written, one of the things that will seem most incredible will be that a nation as far advanced in civilization as the United States is supposed to be, should be weighing its copper by one standard, its silver by another, its diamonds by a third, and its medicines by a fourth, all of them interchangeable only by means of fractions; and measuring its wines by one system, its grain by another and its gas by a third.—Theo. D. Rand.

We consider it of the utmost importance that the inevitable change to the metric system be inaugurated at as early a date as possible. The advantages to be derived from the metric system's adoption are clearly manifest, and opposition to a movement of this kind would seem futile, as, at best, it can only mean a trifling postponement and not, in any way, prevent its ultimate adoption.—The Link-Belt Engineering Co. (J. M. Dodge.)

For more than thirty years we have employed the metric system of linear measurement as being greatly superior for the minute measurements required in the manufacture of watches. In adopting this system we took a centimeter as our unit. This we subdivide into a thousand parts, and have special gages reading to thousandths. In many instances the graduations on our gages we subdivide by the eye. Having this system in use for measurement of watch parts, we also use it in our machine department in the manufacture of machines, and while it is somewhat novel to men when they first come to us, yet they very readily acquire the system, which is extremely simple in computation.—American Waltham Watch Co. (E. A. Marsh.)

We have used the system in our workshop for a number of years, as its units are much more convenient, especially in the fine measurements required in our class of work. We have also published our catalogues of scientific apparatus wholly in the metric system for a number of years, and find that this departure is very much appreciated by the scientific men with whom we deal.—Baush & Lomb Optical Co.

The comparison between the metric system and our system is about equal to dollars and cents as compared with shillings and pence, and I approve any movement which will promote the universal introduction of the metric system, to take effect in the shortest possible time and that will create the least confusion and expense.—Joseph T. Richards, engineer, M. W. (Penn. R. R.)

It would be most satisfactory to have the National Government make the metric system the only legal system throughout the United States, provided sufficient time, say, five or ten years, were given before it became compulsory, so as to permit the different trades to adjust themselves to it.—R. D. Wood & Co.

To argue the superiority of the metric over what we may well blush to admit is still the British and the American system would be a reflection upon the intelligence of the members of the Institute. To my mind the only serious reason for hesitation in pushing the adoption of the metric system is that which, at first sight, appears to be its chief merit, viz., its decimal basis.

The number 10 came to us as a basis of notation through our having each 10 fingers (including thumbs). Its unfitness for the purpose becomes manifest whenever we have occasion to think of the half of a quarter dollar and realize that this half is 12½ cents, bringing us at once into inconvenient fractions. As my good friend, Mr. Benjamin Smith Lyman says, in his paper entitled "Against Adopting the Metric System": "If our early predecessors, in learning to reckon, had but omitted to count their thumbs * * * they would have saved the world a vast deal of labor, and would almost have abolished the use of vulgar fractions."—John C. Trautwine, Jr.

I doubt whether any discussion is needed of the broad subject whether a common system of weights and measures is desirable. That, I think, will be admitted by everyone. Forty years ago the question whether the British system or metric system would ultimately prevail may have been open to discussion. Now the progress of the latter, its adoption by Germany and by Norway and Sweden, its extension in Mexico and South America, its adoption by all scientific men in the researches from which results nearly all human progress have settled that question.

It is not a new thing to change weights and measures. Aside from the recent example set by other nations in the radical adoption of the metric system the English weights and measures have continually undergone change, though the names may have been retained.

The question may be raised, as it always has been, whether the time is opportune for the change. To this the answer seems to be that the difficulties are more apt to increase than to decrease with the lapse of time.—O. H. Tittman (Coast and Geodetic Survey.)

The subject seems to me hardly to require or to permit any extended discussion. It has been familiar to the world, as a question of importance in economics and the industries, in science and in art, for a century, and the system has become general all over Europe and throughout the world, except in the United States, Great Britain and their colonies. In some cases it is used in these countries, and in others generally in their dependencies. The advantages and relative disadvantages of its adoption are perfectly well understood, and have been illustrated by every nation which has accepted it. No nation now enjoying its advantages could be induced to exchange it for our heterogeneous "system" of weights and measures—our no system, rather—and the testimony in its favor from those who have had experience and are best entitled to give trustworthy evidence is practically unanimous. The only voices against either the system itself or its adoption are usually raised where that experience has not been had. It is making progress, slow to be sure, but none the less steady, in our country and in Great Britain. The question is not, after all, on its adoption, but rather regarding the time and the rate of advance toward its installment as a national and officially accepted system.—Robt. H. Thurston.

If called upon to adopt the metric system in any establishment under my control I would make no immediate change

in any of the tools, but use them as they are, merely denominating them in the nearest convenient metric unit. For example, call an inch 25 millimeters, and so on with any multiple or subdivision of the inch. It would be urged against this that there is no correspondence between the absolute and nominal dimensions of the tool. This, although very desirable, is not absolutely essential; in fact, in many of our tools, the dimensions are only nominal and not exactly real. It would be desirable, however, to begin to make new gages and tools to replace the old ones as they were worn out. These could be made of actual dimensions to correspond closely with the nominal. The consequence would be that workshops would have for a period two standards, the old and the new; the old applying to all existing products and designs, and the new tools to be applied to new designs and products. The former would gradually disappear and the latter would in time entirely take their place. The manufacturer simply would maintain a double standard—all named in metric units—the one gradually disappearing to be replaced eventually and entirely by the new standard.

The subject of screw threads is frequently quoted and the difficulty and confusion that would result if we were to attempt to change our present system. I may ask, in reply, why change it at all? If it is good, retain it as it is indefinitely.—James Christie.

If we were to go to Germany—any one of us—to start a workshop we would not undertake to start it on an English-speaking basis; we would learn the German language, and we would do our business in German. Now, if we are going to adopt the metric system, all we will have to do will be to learn to think in the metric system. I have known men who have been able to master enough of the German language in three weeks to get along splendidly in Germany. How is this done? Simply by the professor compelling the person to stop thinking in his own language and to think in the language he is going to adopt. When he is compelled to think in that language, it is a very easy matter to teach him to speak in that language; and therefore, instead of making our articles four or three feet long, we would make them a meter long, or a meter and a half long; everything that we would make we would think about in accordance with metric sizes and metric dimensions.—S. M. Vauclain (Baldwin Locomotive Works.)

Opposed to Metric System.

The disadvantage of the French metric system is, that it is an attempt to measure time, space and matter decimally, whereas the decimal system is only specially adapted for computing numbers.

Assuming the advantages of the metric system for purposes of computation, and as the length of the French meter is not a necessary part of the system, would it not be desirable to adopt a metric system for this country with a length for the meter of 40 inches, whereby 25 millimeters would exactly equal 1 inch, with measures of weight and capacity based on this meter as in the French system, so that the system could be used decimally or by whole numbers and fractions as in our monetary system?

Would any advantages claimed for the metric system compensate us for abandoning the standard inch and our fractional and decimal divisions of it, with our engineering literature based thereon?—Wm. Sellers.

The writer was at one time connected with an establishment wherein the metric system was employed in one department and the English system in the rest of the works. It was his experience that foreigners who were used to the metric system, after learning our system, preferred to work with it than with the metric in making drawings; in other words, preferred to work in the department using our present system, rather than in the department where they used the metric.

The writer spent some time abroad a few years ago, and found that for convenience, they used as few decimals as possible upon their drawings, as it was difficult in many places to find room for the figures, just as we try to avoid fractions containing too many figures for convenient insertion.—Southwark Foundry and Machine Co. (Jas. C. Brooks.)

Decimal subdivision may facilitate computation on paper, especially in adding up many digits, but reckoning in the head is much more easily effected with a subdivision by halves or thirds. That is clearly the reason why such fractions are in constant use in the stock market, even with our much vaunted decimal currency established more than a century ago. In a multitude of cases, too, it is easier to make a computation with those easy fractions than to undertake it with the more cumbersome tenths, hundredths and thousandths. Plainly, the mental computations are by far more frequent than ciphering, and would be still more so were we not somewhat tied down to the pencil by the decimal system, as the Chinaman is to his abacus.—Benj. Smith Lyman.

In the absence of convincing argument to the contrary, we would feel, first, that the metric system in itself is not a better system than the English for the purposes of engineering trade; and secondly, even granting its merit, we question whether any such enactments of the National Government would accomplish the desired ends. We believe the American people are too much wedded to the English system to give it up because of any national legislation.—Brown and Sharpe Mfg. Co. (Henry D. Sharpe.)

In answer to question 3, (Have any valid objections against the metric system been urged excepting that the numeration cannot be continuously subdivided by two?), I would say that there are many more valid objections than the one presented in that question. The meter is too large as a unit and a millimeter is too small for uses in the average manufacturing process. The use of the decimal point on drawings and the use of dimensions expressed in decimals is exceedingly inconvenient. The scale of drawings using the metric system is much less convenient than the scales which are derivable from our present units. If it were not the case that some people thought the change desirable, it would be without meaning to have the National Government enter the thin edge of the wedge. There is much productive business in the country bearing no relation to the general government, and those establishments which supplied both the government and general public would be put to the expense of carrying everything in double standard.—F. R. Hutton, Prof. M. E., Columbia University.

The ones particularly affected are the manufacturers, whose standards are all prepared under the duodecimal system; any change to a decimal system would mean to such manufacturers a very great confusion for a number of years, and while I am sure every one would be pleased if all our measures were under the metric system, it becomes a financial question rather than a theoretical one.—New York Shipbuilding Co. (Henry G. Morse.)

In this connection I desire to call the attention of the members of the Institute to an interview I had in 1884 in England with Sir Joseph Whitworth, who, as you are aware, was noted for his improvements in the design of machine tools and the preparation of standard gages, etc. (He at that time was in feeble health, and in point of fact was called from this life a short time afterward.) He raised the question of the futility of asking foreign nations to adopt the standard of England even with improvements as to the simplification of the units of measurement and weight, but he urged that I should use my influence to have the United States in the first place adopt the meter of 40 inches in place of that now represented by a rod of platinum in the archives at Paris, measuring 39.371, approximately. This change would add only $\frac{5}{8}$ of an inch to the length of the French meter, and this would appear less in its subdivision, but it would result in an exact correlation between the English unit and its multiple and the metric system. As the comparison now exists, we have the anomaly of assuming 25.3995 millimeters to be equal to 1 inch, while if the change suggested by Whitworth were made, our unit would be 25 millimeters exactly; 100 millimeters (1 decimeter) would be 4 inches exactly; 300 millimeters would equal 1 foot, and 900 millimeters would be 1 yard. The difference of weight that would result from the cubing of these dimensions, or any portion of them, and their contents in the weight of distilled water at a certain temperature, would be insignificant. Already by Act of Congress it has been determined that for postoffice uses, 15 grams French weight shall be taken as equivalent to ½ ounce, although the weight of 15 grams is slightly more than the weight of the ½ ounce of the postoffice measurement.

A tailor in France or Germany or any other country where the French metric system is legalized has a tape-measure divided into centimeters and half centimeters, precisely as a tailor in America has a tape-measure divided into inches, halves and quarters. The finest measurement they have occasion to use is respectively ¼ of an inch in America, and 5 millimeters or approximately 1-5 inch in France or Germany. The division of material bought and sold by weight into halves and quarters, is natural to the human mind. Its division into fifths or tenths is not conceivable. What is possible in money is not practicable in the market. Half of the kilogram, nearly the equivalent of the pound, had to be legalized in France and Germany, and this again is subdivided into quarters, and not into ten parts, in such materials as meat and butter.—Coleman Sellers.

The government is a large buyer of many kinds of manufactured products, and, in order to buy at reasonable rates, must buy what the market supplies; that is, must use what other purchasers require. For example, we have certain standard sizes of pipes and fittings threaded with so many turns per inch; these are well recognized, and we are able to buy pipe of one man and valves or other fittings of another man with reasonable certainty that they will fit one another, and many expensive tools and gages are required to produce this degree of uniformity. Is it intended to forbid the government to buy such pipe and fittings and require it to have made special pipes in millimeter sizes with threads in millimeter pitches? It is hardly conceivable that any one understanding the subject should recommend such a course.

The case is the same with our convenient series of bar sizes, our sheet and wire gages, our bolts, nuts and screws and many other commercial standards in all branches of business. It is true that these conventional sizes are perhaps more or less crude and imperfect; but they are well understood and serve

their purpose, and experience has shown how difficult it is to change them when better series have been suggested. It is said that we need not change any actual sizes, but simply call them by new names. For years we have been trying to increase the accuracy of the sizes of things—to have the inch bar or the inch bolt measure 1 inch in diameter and not more or less; but if we must call our 1-inch bar a 25-millimeter bar, which it is not, it seems to me we are retrograding instead of progressing.—C. Sellers, Jr. (Wm. Sellers & Co., Inc.)

Were we to pass upon the simple question of the advisability of having a uniform standard throughout the civilized world, and without regard to the inconvenience and expense incidental to the change, we would decide in the affirmative. We would also be an advocate of adopting the metric system on account of its being more universally used than any one system, rather than to attempt to force the British standards, even though considered as convenient.

In a general way we are in favor of a common system of weights and measures, and the system should be the metric. On the other hand, considering the matter in connection with our own manufacture, or, to make it more definite, we do not believe the time is opportune for adopting this system, as it would lead to considerable expense if it were carried out to a degree that would make it an international benefit. We could readily, and without much expense, express dimensions of tools, fixtures, etc., in metric symbols, but would this be any real advantage unless the pieces so expressed were exact duplicates of similar pieces in use by countries whose standard is the metric system?—Bement Miles & Co. (W. J. Hagman.)

The millimeter is too small for the purposes of the workshop, in that it has to be multiplied many times if decimals are to be avoided and if all the other subdivisions of the meter are to be avoided. If the meter is the unit, then, of course, the decimal point would have to be used.

The Navy Department has, as we all know, adopted the Franklin Institute or Sellers thread for bolts and nuts. That system enters into all construction by the Navy Department and has been used for a great many years. It was on the recommendation of the Franklin Institute that this thread was adopted by the department, and the change to the metric system for the Navy Department in that one item alone would be a serious matter. It would be almost impossible to make the change in even units so as to make the work as interchangeable as it is now required. The railroads, also, have adopted the United States standard thread, and it is now in use on every railroad of the country. These standards are all in English measure, and the pitches are English; so that there would have to be a translation, which means a good deal of trouble and expense.—George M. Bond.

* * *

GEAR CUTTER ATTACHMENT FOR CUTTING INTERNAL GEARS.

From time to time we have described some of the interesting tools and devices devised by different members of the Arthur Co., New York, and again have an opportunity to present one to MACHINERY readers. The present instance is a gear cutting machine attachment designed by Mr. John F. Arthur for cutting internal gears. The firm of which Mr. Arthur is secretary, make a specialty of gear cutting and have designed and

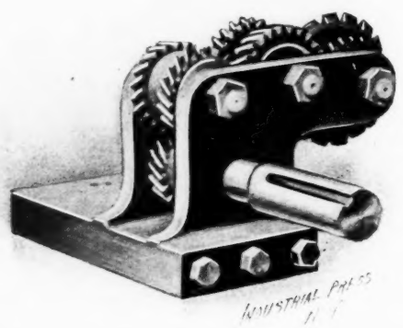


Fig. 1. Internal Gear Cutting Attachment with good Features of Design.

built a number of interesting gear-cutting machines for spur and spiral gear cutting. So the device illustrated in the accompanying cuts, is in line with their regular work.

The attachment for cutting internal gears, is shown in Figs. 1, 2 and 3, the first view being made from a photograph and the others from the working drawings, to show the construction. The device consists of a cast iron frame made in two parts which carries four spool gears for transmitting motion from the machine spindle to the cutter. Fig. 1 shows that these gears are right- and left-hand spirals. They are made in this way, of course, to get the smooth driving action characteristic of spiral gearing, and to avoid the end thrust that accompanies single spirals. The gears are alternately steel and bronze; that is, gears *E* and *C*, Fig. 3, are bronze and gears *D* and *A* are steel. The steel gears turn on bronze bolts and the bronze gear *C* turns on a steel bolt. The reason for this is to have both the gears and their bearings in contact with different metals in order to get the best wearing results. This of course does not apply to the bearing of gear *E* as it was necessarily mounted on the driving arbor attached to the machine spindle.

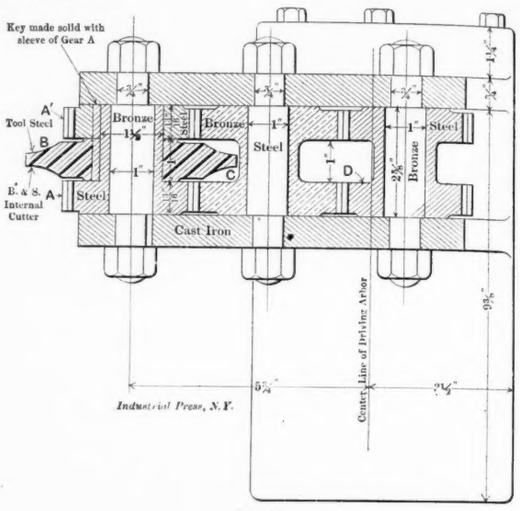


Fig. 2.

Gear *A* is made in two parts designated *A* and *A'* in Fig. 2. A portion of *A* is turned to a sleeve of smaller diameter to form a seat for the cutter *B* and the gear *A'* The end thrust of *A* and *A'*, when driving the cutter in the proper direction, is toward the cutter, thus tending to hold them solidly against the cutter. The advantage of this is obvious since if the spirals were reversed the thrust would be outward which would necessitate a fastening device to hold them to the cutter. Otherwise the thrust would force the gears against the side walls of the frame and cause excessive friction. Another excellent feature of design of this portion of the device, is

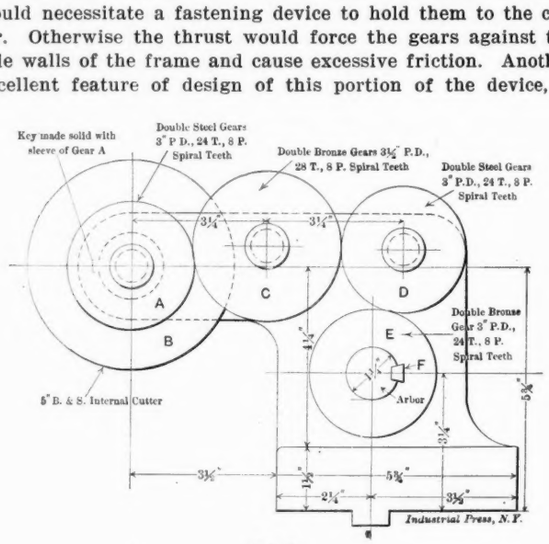

Key made solid with sleeve of Gear A
Double Steel Gears 3" P.D., 24 T., 8 P. Spiral Teeth
Double Bronze Gears 3¼" P.D., 28 T., 8 P. Spiral Teeth
Double Steel Gears 3" P.D., 24 T., 8 P. Spiral Teeth
A
B
C
D
E
F
Double Bronze Gear 3" P.D., 24 T., 8 P. Spiral Teeth
5" B. & S. Internal Cutter
Arbor
Industrial Press, N.Y.

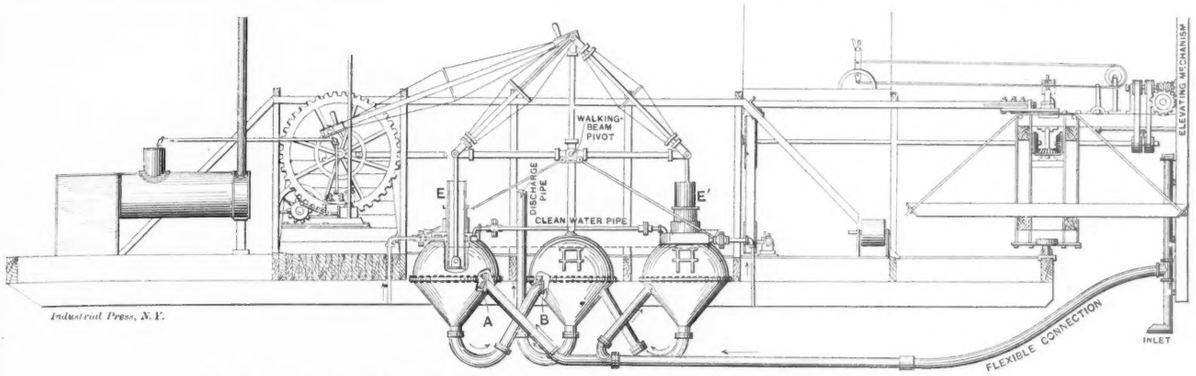
Fig. 3.

that the key driving the cutter is integral with the sleeve of *A*, being machined from the solid. We may also call attention to the key, or feather *F*, for transmitting motion from the arbor to the gear *E*. This is made dovetail form and tightly fitted in *E*. The sides of the feather are made radial in the arbor. This type of driving feather has been used for a number of years by the Arthur Co. in their various machine tools. The good features of this form of construction were commented on in the June, 1902, issue in connection with "Some Features of Rolling Mill and Engine Design."

Special B. & S. cutters, 5 inches in diameter, are used on the attachment. The extreme width of internal tooth that can be cut is 3½ inches.

RECLAIMING GOLD FROM THE BEDS OF RIVERS —NOVEL GOLD DREDGING MACHINE.

Prof. Shaler, the noted geologist of Harvard University, declared a year or so ago that he believed the total production of gold throughout the world would eventually be greater than that of silver. He pointed out that while silver is obtained in large quantities, it is only gained by expensive mining operations, so that the price per ounce must always cover a relatively large labor cost. In the case of gold, however, there are possibilities of obtaining great quantities at a comparatively low labor cost by river and ocean dredging. There are great deposits of gold-bearing sands at the mouths of all great rivers draining gold-producing area such as, for instance, the Sacramento in California and the Yukon in Alaska. These gold-bearing deposits could be handled in immense quantities if the proper dredging machinery was provided, and at very low expense. Professor Shaler predicted that dredging machines would be so perfected that the lifting and separating of the precious metal from the ocean deposits would cost so little in proportion to the amount of gold recovered that it would become a most profitable and productive industry, since it is one that would only be limited by the number of machines at work, the supply of gold-bearing sands being practically inexhaustible.



The Bewsher Dredging Machine for Operating in the Gold Bearing Deposits in the Mouths of Rivers.

The production of gold by the present methods on land is an enormously wasteful occupation, considering all the miners and prospectors engaged in it and the total return. It has been estimated by competent authority that every dollar's worth of gold in circulation at the present time has cost a day's labor or more in the aggregate. Some men have won great prizes, but many have gained nothing and perhaps lost their lives in the search. The gold-dredging machine when perfected after the conception of Professor Shaler would make a fixed daily production almost an absolute certainty.

A novel machine for gold-dredging is illustrated herewith, known as the Bewsher dredging pump, which will be found somewhat interesting on account of certain mechanical features. One of these is that the pumps are in effect mechanical pulsometers. That is, they can handle muddy, gritty water or even water carrying large pebbles without damage to the working parts, the same as the steam pulsometer, but at a much higher efficiency in the matter of steam consumption. This machine is designed for river dredging, where the gold bearing deposits may be discharged on land and there passed through sluice boxes. For ocean work it would, of course, be necessary to have all the apparatus on board and to have the dredge a much stronger and more seaworthy vessel.

The pumps *E E'* are attached to opposite ends of a walking-beam which is operated by a 20 H. P. steam engine. As a plunger rises the water from the ocean or river bottom flows through the 8-inch inlet pipe into the large receiving chambers and at such velocity that the mud and pebbles are lifted bodily, carrying the gold nuggets and fine gold with it. Twelve cubic yards are handled per minute, which means a velocity (17 feet per second) sufficient to carry 25 per cent of granular matter in suspension or three cubic yards per minute. To prevent the grit getting on the plungers and cutting the wearing surfaces a spray of clean water is constantly injected around the plungers just beneath the stuffing-boxes. Clack valves are provided with leather hinges to act as checks. These hang in a perpendicular position, which reduces to a minimum the possibility of sand and pebbles preventing their seating properly. The advantage of sucking the deposits from the bed instead of lifting them mechanically, as with a bucket dredge, is that it causes only a local disturbance at the mouth of the inlet pipe. A bucket dredge, on the other hand, disturbs a large area of the bottom and constantly tends to cause the gold to sink lower and lower, where it finally becomes out of reach. Gold has a specific gravity of about 19.3, so it always seeks the lowest levels, tending all the while to lodge in cavities and crevices where it cannot be recovered except by a powerful suction. The general appearance of the machine shown is crude, and the design, aside from the central idea, is not attractive, but it appears, nevertheless, to have possibilities that may make Professor Shaler's prophecy come true before long.

* * *

RAPID WORK WITH STEAM SHOVELS.

Probably the most interesting steam shovels in the world are to be found on the "Mesabi Range," one of the five districts which go to make the Lake Superior mining region. Here they render possible in its present scale of magnitude the so-called "open-pit" mining, the shoveling of iron ore directly from its natural resting place in the earth to the railroad cars which are to carry it to market. An "open-pit" mine is nothing more nor less than an immense hole in the ground, perhaps half a mile square. Into this railroad sidings are run, as they might be into a vast stone quarry, and in some of these mines, where fully a million tons of ore are taken out each year, there are in operation simultaneously anywhere from half a dozen to a dozen of the large shovels.

Remarkable records of rapid loading are made by these shovels. As a rule five trips of the dipper are required to fill an ordinary freight car, but so rapidly is the long arm raised and lowered that it is accounted slow work if more than five minutes be consumed in loading a car, and not infrequently cars are fully loaded and pushed out of the way of the shovel at the rate of one every two minutes. From eight to a dozen men are required to operate a shovel of fair capacity, and by steady work they can place fully 7,000 tons of ore aboard the cars in a single working day. In order to make such a record as this, however, it is necessary that the men have an opportunity to work on the side of a pit or mine, where it will not often be necessary to resort to blasting to loosen the ore, so that it may slide down to the shovel, and it is further essential that a locomotive be constantly at hand to shift the cars as rapidly as they are filled, thus preventing delay.—*Philadelphia Record.*

* * *

The following wonderfully intelligent note recently appeared in a New York daily:

That it pays to use a smoke-consuming plant has been demonstrated at the New York Post Office. The building was formerly provided with a 6 horse power steam plant that used 24 tons of hard coal a day. This plant was removed and a 12 horse power smoke-consuming plant put in its place, which uses only 18 tons of soft coal a day. Thus double the power is obtained from one-fourth less coal, and, while money is saved, no nuisance is created. This seems to show that a smoke-consuming apparatus will soon pay for itself.

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MACHINERY

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FRED E. ROGERS and GEO. H. HALL, Associate Editors.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

NOVEMBER, 1902.

NET CIRCULATION FOR OCTOBER, 1902,—24,183 COPIES.

The entire Engineering Edition is printed on coated paper, and a data sheet is furnished with every copy—price $2.00 a year. The Shop Edition is printed on super-calendered paper—price $1.00 a year.

THE LIGHT UNDER THE BUSHEL.

A somewhat remarkable example of the policy of secretiveness which some manufacturers are wont to adopt occurred at a recent meeting of the American Electrochemical Society, at Niagara Falls. Of the score or more electrochemical industries in that city only five permitted the delegates to the convention to visit their works. Of these five were, the Carborundum Co., well known to our readers, and the Atmospheric Products Co., to whose remarkable work we referred in our July number.

While we are well aware that there are cases where it is advisable to withhold information about processes and to keep one's methods secret, we believe that more often it is a mistaken idea. Does anyone suppose that the five industrial establishments at Niagara where visitors were admitted will suffer from their open-door policy or lose money or business that might have been retained had "No Admittance" signs been posted there? Or is it probable that those who declined admission will have acquired benefits thereby that will not be shared by their more liberal neighbors? On the contrary, the latter secured some valuable free advertising that will almost certainly bring results at some future time.

We recently visited an establishment, with a view of writing a description of its general practice. A simple method of chucking a piece in the lathe was alluded to by the proprietor with the request that a description of it be left unpublished, as it was, in a sense, a proprietary idea, originated in the development of the business. Of course the request was granted, but in visiting a rival concern in another city a little later, precisely the same process was found to be in use there. This is what might have been expected, for every live, enterprising concern generally has methods which compare favorably with those of competitors, accomplishing substantially the same results and in about the same time; otherwise it would not be able to compete. As a matter of fact it is not possible to keep much information of this character a secret where workmen are employed who are liable to change positions, who talk with workmen in other factories and who travel to a greater or less extent. In these days it is seldom that a firm has a process that is not known or used somewhere else, at least in an equivalent form. People who have advanced to corresponding levels in civilization generally have and do about the same things, whatever their color or place of birth, and many instances could be quoted to show that a similar law holds in the development of industries.

And how is it with the individual workman? Years ago a machinist acquired his information and skill through his own personal experience. It was his stock in trade and he was very reticent about giving away to others what had cost him so many years of hard work to learn. But education has changed all this, and to show how such is the case we are able to quote a very apt sentence from one who is a foremost leader in the practical education of practical men:

In a recent address, President Pritchett, of the Massachusetts Institute of Technology, says: "One of the great advantages of education is the preparation which enables a man to learn from other people, without having to wait to learn, bit by bit, from his own hard experience." The experience of those who have gone before is to be found in books; of those who are working to-day, in the technical papers; and one can acquire many times as much information from these sources as he could obtain without them. He can also gain information by traveling and by observation. There is so vast a store of common knowledge to be had from these sources that, except in very rare instances, a man will gain nothing whatsoever by trying to withhold the little mite he has himself found out. If a man has really become proficient in any line of work let him publish his ideas, tell other people about them, explain his methods, and do as much as he can to teach others the same work. If his methods are found to be good ones his fame will widen, he will be consulted as an authority and will be in demand as a workman. If he does not do this, he may feel reasonably sure that some other person will, and that this other person will be the one who will eventually pull ahead, other things being equal.

* * *

THE ENGINEERING AND SHOP EDITIONS.

The many expressions of approval that have come to us regarding the engineering edition of MACHINERY indicate that the paper in its new form will meet the needs of a much larger number of readers than ever before. The reason for this is obvious. There is a demand for a publication dealing with the design, construction and operation of machinery, which covers its field in a complete manner. We have long realized that it was not possible to publish a technical periodical at a dollar a year that was as complete as it should be to enable one to keep in touch with mechanical thought and progress, and the two-dollar or Engineering Edition is the result.

Several subscribers to the dollar or Shop Edition have asked us whether, if they change to the Engineering Edition, they will still have all the matter contained in the Shop Edition. In reply, the Engineering Edition contains all the reading matter and advertisements appearing in the Shop Edition, and there are, besides, from 16 to 24 pages of general and current engineering matter. A data sheet containing four 6 x 9 pages of notes, tables, charts, etc., for notebook use also accompanies every number of the Engineering Edition.

In addition to articles upon machine design and general engineering subjects, the extra pages contained in the Engineering Edition have several features that make the paper of great value to a person wishing to keep in touch with mechanical progress without having to take the time necessary to look through a large number of different publications. Among these are: A summary of the leading technical and mechanical events of the month; a digest or summary of the most valuable articles appearing in the other technical papers; and a summary of the most valuable papers presented before the various engineering societies.

As stated above, the price of the Engineering Edition is $2.00 a year, or double that of the regular edition that has heretofore been published, and it will be found more than twice as valuable to the busy technical reader. The Shop Edition corresponding to the regular edition heretofore published is issued at $1.00 a year. Most of the matter of a technical nature upon machine design that has sometimes appeared will now be transferred to the Engineering Edition, giving more room in the Shop Edition for articles upon shop methods.

SPUR GEAR PLANER.

A MACHINE FOR PLANING LARGE SPUR GEARS BY THE USE OF A SINGLE-POINTED TOOL AND TEMPLETS.

The Newton Machine Tool Works, of Philadelphia, have recently furnished the R. D. Nuttall Co. with a gear cutting machine of unusual capacity and embodying many new and interesting features. While the operation of the machine is similar to that employed in some of the bevel gear shapers, this is an original application of the principle to the formation of spur gears. A good general idea of the machine is gained from the half-tone, which was taken before the machine left the shop. When in place, the top of the dividing table will be nearly flush with the shop floor and most of the indexing mechanism will be below the floor line. The gear, lying flat upon the dividing table, is accurately spaced around by the dividing mechanism shown at the left of the cut, and the teeth are shaped to templets by a tool carried in the vertical slotter. This slotter has a stroke of five feet and is driven by a spiral gear connected to the bevel gearing shown on the countershaft. The countershaft itself is driven by a motor enclosed within the column. The vertical column can be moved in and out to any desired position on the extension bed and will accommodate gears up to 30 feet in diameter. If a greater capacity was required, the bed could be extended indefinitely to take any size of gear.

Figs. 3 and 4 show a section through the tool apron, or saddle, and the mechanism by which the tool is fed. As the saddle is raised and lowered the star wheel *A* is revolved by engaging with the pins *B B*. During the upward stroke no motion is produced, owing to the star wheel working on a ratchet, but as soon as the apron begins to descend, the pin gear, operating through the feed gears, causes the screw *C* to revolve and thereby feed the apron across the face of the column. With the feed gears *D* and *E*, shown in Fig. 4, in use, the apron would be fed to the right, but if these are removed and the combination shown in Fig. 3 substituted, the introduction of the extra gear *F* causes the apron to be fed to the left. Upon either side of the apron are the steel points *G G*, Fig. 2, and as the carriage is fed to one side or the other, these points come in contact with the templets which are held in the templet holders *H H*. This guides the movement of

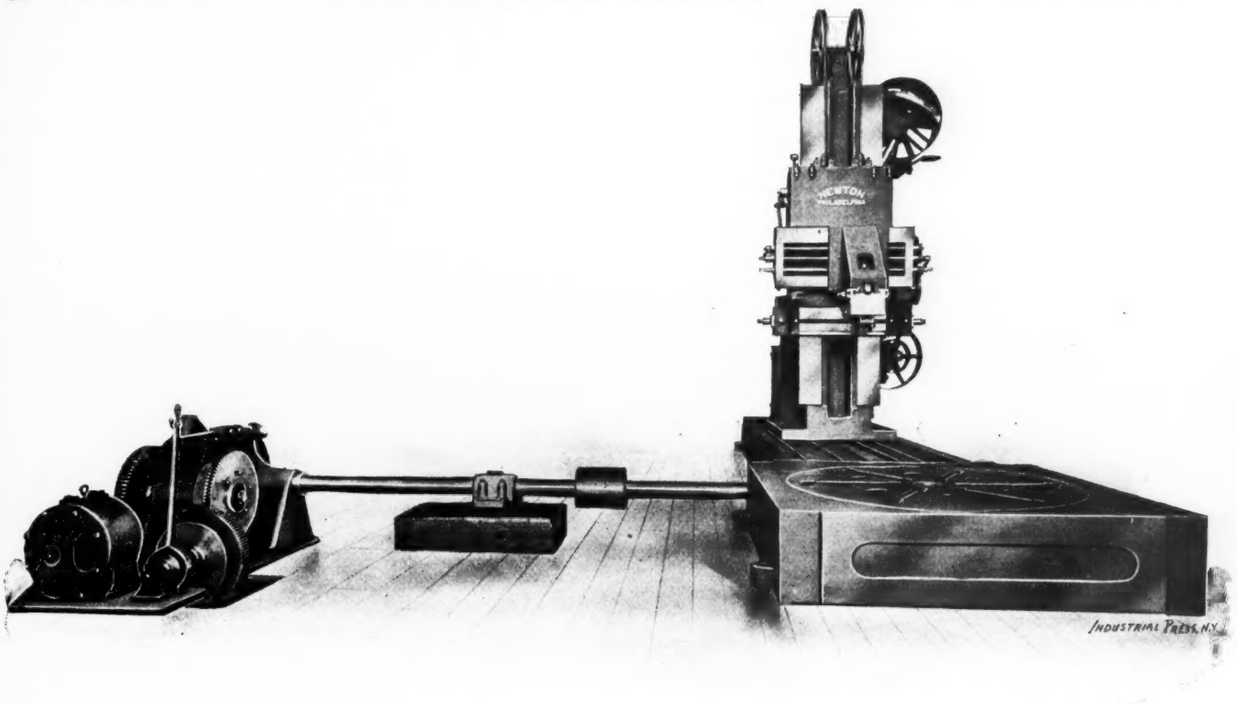


Fig. Spur Gear Planer.

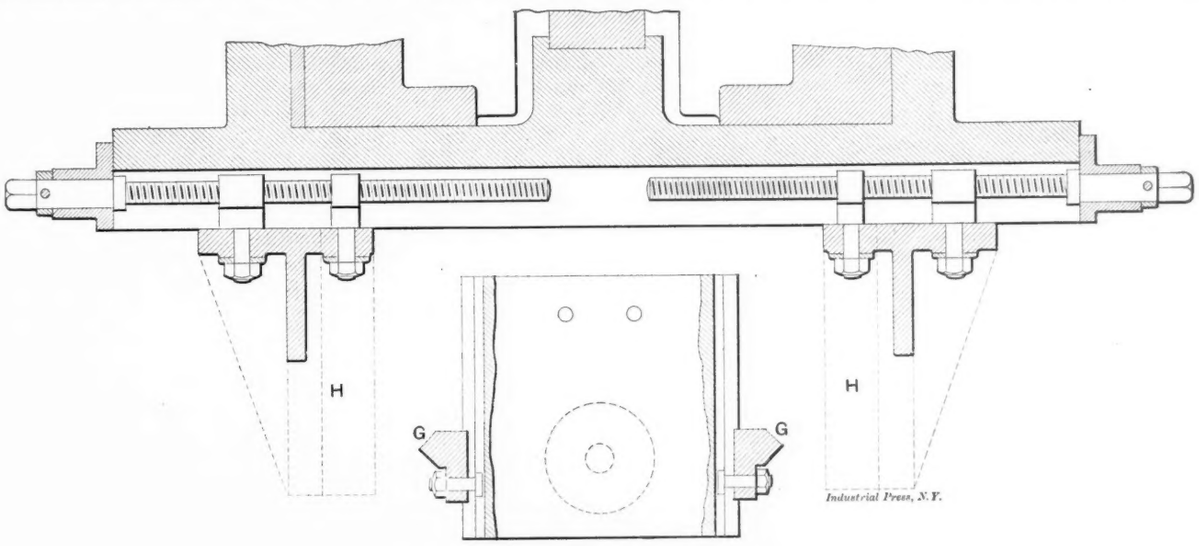


Fig. 2. Section through Guides and Templet Holders.

the tool to conform with the shape of the templet. As the revolution of the star wheel would have a tendency to feed the apron farther than the templet allows, a friction clutch, *I* in Fig. 5, on the star wheel shaft allows the feed to slip as soon as the point *G* touches the templet.

While the head is being fed crosswise, the tappet *J*, striking against the top of the lug *K*, revolves the gears *L*, *M* and *N*, and then through the chain of bevel gears *O*, *O*, *O*, the screw *P* is revolved, thus feeding the tool in the tool-post up to the work. A hinge and spring mechanism on the tool-post allows the tool to spring downward on the return or upward stroke.

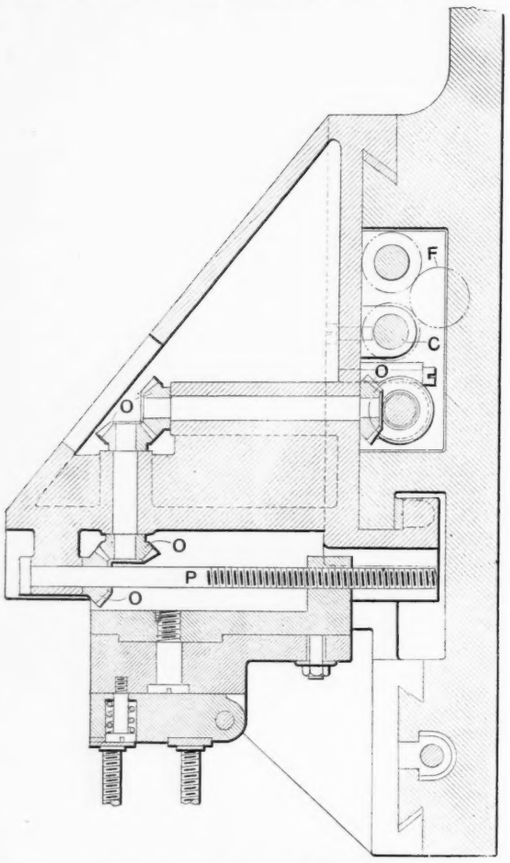


Fig. 3. Section through Tool Apron.

A section through the dividing table is shown in Fig. 6.

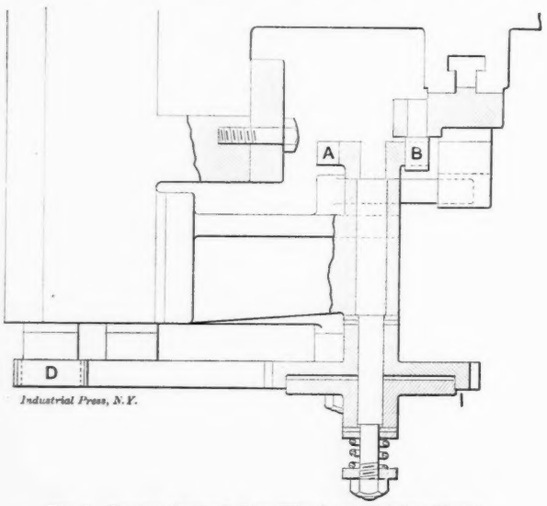


Fig. 5. Section through Star Wheel and Friction Clutch.

This table is, in effect, the upper side of a large worm gear which is driven by a worm on the shaft *P*. Fig. 7 shows the indexing mechanism for revolving this table. The motor having been started, the plunger *Q* is raised by means of the lever *R* and this leaves the gear *S* free to rotate. The friction lever *T* is now thrown over, putting the friction clutch in mesh, and the worm wheel *S* then revolves until checked at the end of a complete revolution by the plunger *Q*, which has by this time reached its former position at the bottom of the slot, thus preventing further rotation of the wheel *S*. The friction clutch then slips and the motor is stopped. Motion is transmitted from the worm *S* to the worm shaft *P* through the intermediate gears *U* and *V*, the sizes of which are varied to give any desired divisions to the revolution of the gear that is being cut.

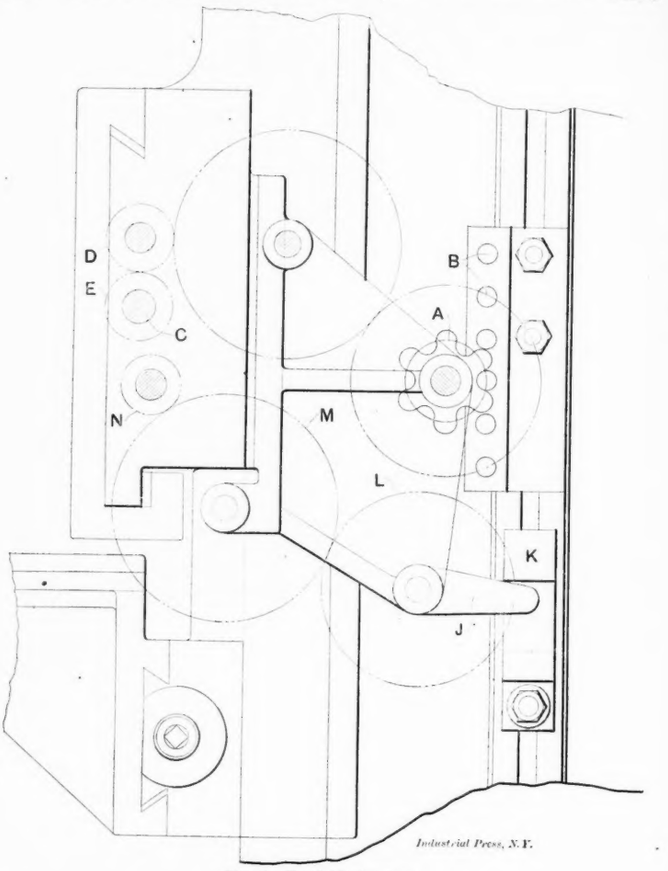


Fig. 4. Feed Mechanism.

When internal gears are cut the vertical column is transferred to the dividing table, the internal gear remains stationary, and the slotting machine itself is indexed around to each tooth. When completed, this machine was tested by means of a transit placed on the dividing head. This was sighted on a point about 40 feet distant so as to multiply the error, which proved to be almost imperceptible.

* * *

NEW INDUSTRIAL CENTER.

The plants of the affiliated Westinghouse companies, Pittsburg, have become so extensive that there is little available room at their present locations for future building extensions. To provide for future growth it was necessary to go outside of the city limits and a new industrial center has been opened up about 17 miles east of Pittsburg. The new settlement is on the Pennsylvania Railroad and is to be known as Trafford City, where extensive factory sites have been laid out and every provision made for a comfortable and healthful residence section for the employees. The manufacturing plants will be located on a fairly level area between the Pennsylvania Railroad and the residence portion of the city, which will be reached from the railway station by a steel viaduct 1,100 feet long. The residence district has been laid out upon hillsides and on a generally level plateau, high enough above the factory sites to render it free from smoke and dirt. The city consists of two oblong areas, one of which is about ½ mile by 1-5 mile and the other ½ mile by 1-7 mile, the two areas meeting in such a way as to form a reversed letter "L," the corner of which is the most northerly part. The town has been laid off into about 800 building lots, each with an average frontage of about 30 feet and a depth of 100 feet.

In addition to this, space has been left for six parks. The new town is connected with Pittsburg both by the Pennsylvania Railroad and by street railroad.

The factory site, located in a bend of Turtle Creek, provides room for nine factory buildings, each about 200 feet by 800 feet. A system of railway yards and tracks serving this area has been laid out in a very thorough manner, providing a track alongside of each building and transversely through each end. The storage tracks, in connection with this, occupy an area of about 300 feet by 200 feet.

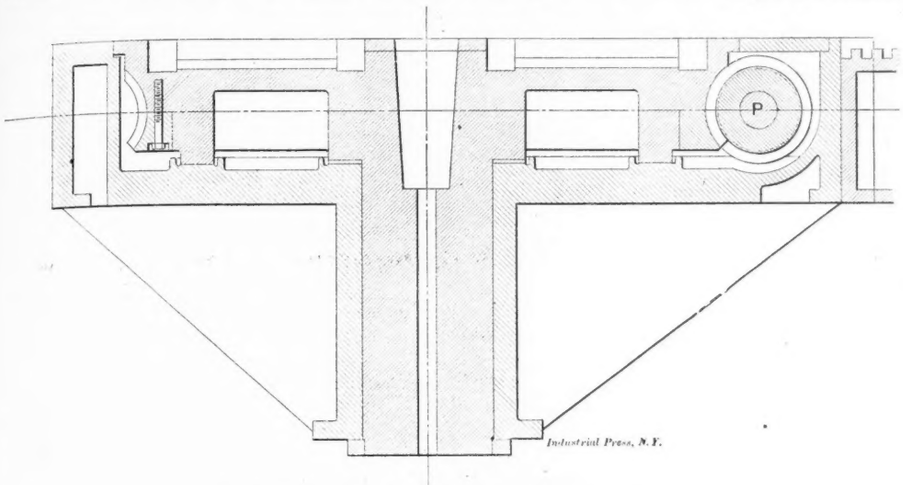


Fig. 6. Section through Dividing Table of Spur Gear Planer.

The first of the Westinghouse companies to erect buildings in the new city is the Westinghouse Foundry Co., which is putting up an extensive and model foundry plant and pattern shop. The immediate necessity for this comes from the increase in the engine and turbine business of the Westinghouse Machine Co. The pattern making and storage building is to be of steel and brick, 605 feet long and 80 feet wide. The pattern shop occupies two floors at one end of this building, the second floor being suspended from the roof trusses in order that the first story may be free from columns. The other end of the building is to be used for pattern storage and will have three floors. The foundations are of concrete and the superstructure of steel and brick. The foundation of the ground floor is made up of 8 inches of concrete into which the floor sleepers are bedded and on top of these is a layer of 2-inch maple flooring. The upper floors in both the pattern shop and storage building are supported on steel beams and steel girders, and are made up of 3-inch yellow pine flooring. The roof purlins are steel I beams spaced 8 feet center to center, and covered with 3-inch roof sheeting which is covered with slate.

The foundry building is 611 by 184 feet, and as in the case of the pattern shop, the foundations are of concrete and the superstructure of steel and brick. The foundry is divided transversely into three bays, the center bay being 80 feet between centers of columns and having runways for electric traveling cranes of 150 tons lifting capacity. The two side bays are 50 feet wide and have runways for 50-ton cranes. At one side of the foundry building runways are provided for yard traveling cranes of 100-foot span and a lifting capacity of 75 tons.

At the middle of one of the side bays, where the cupolas are located, is a charging floor about 50 feet square, constructed entirely of steel. The melting equipment of the foundry will consist of two air furnaces, each having a capacity of 30 tons, and three cupolas capable of melting 18 tons per hour each. This will enable a casting weighing as much as 100 tons to be easily poured and the casting can afterwards be lifted out of the sand by one of the 150-ton traveling cranes.

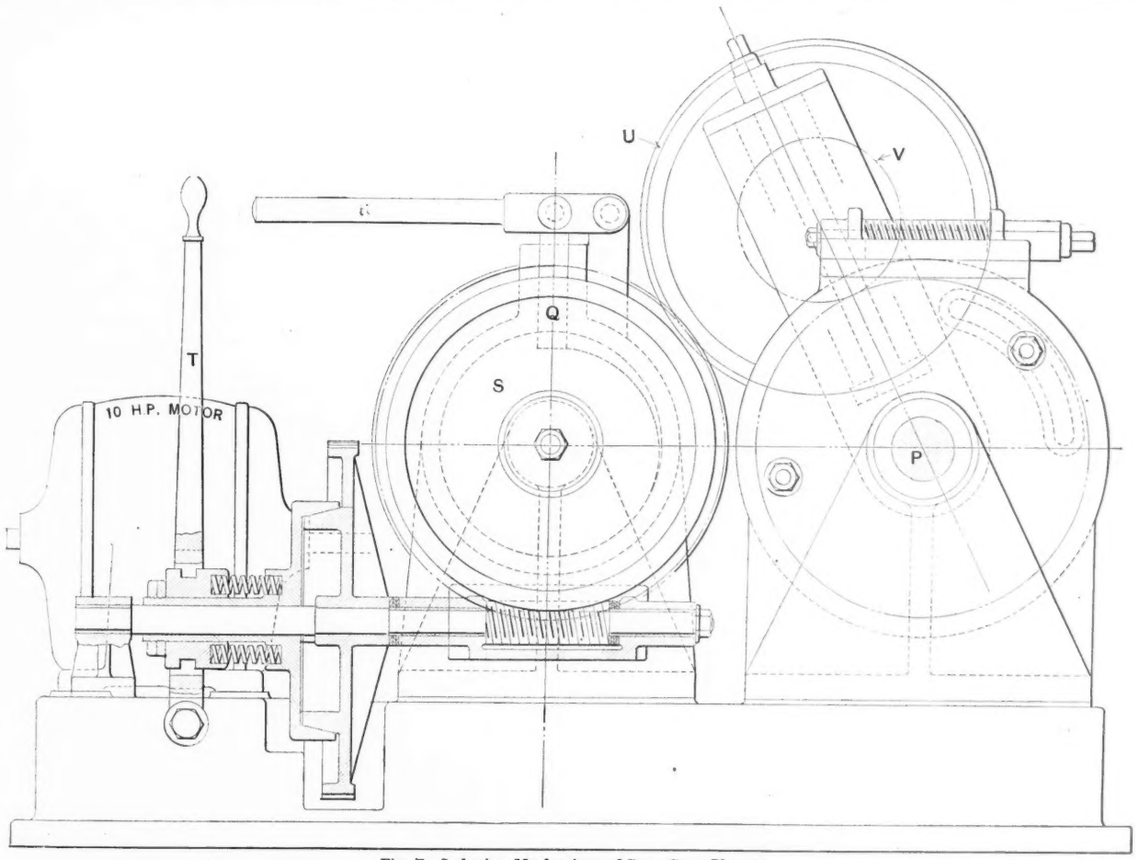


Fig. 7. Indexing Mechanism of Spur Gear Planer.

LETTERS UPON PRACTICAL SUBJECTS.

REGARDING LETTERS UPON PRACTICAL SUBJECTS.

Editor MACHINERY:

It is a noticeable fact that among practical mechanics, those who work at the bench, those who stand day after day at the machines, and those who as foremen have the active direction of everyday work, the features of a mechanical publication which are intended to give "the greatest good to the greatest number" are more or less misunderstood.

The "letters on practical subjects" are generally from men of ripe experience who endeavor to write on such matters as may be useful to many of the younger mechanics who are ambitious to profit by the experience of their elders, as well as to "find out things for themselves." A letter may sometimes seem to have been written to fill up space, when in reality nothing was farther from the author's thoughts. To another reader the same letter may prove to be of the greatest value.

Those who write these letters usually have something to say worth reading by a large number of people. They do not aim to write of matters absolutely *new*, or of subjects upon which no one has ever written before. Very few things are really new. Solomon said there was "no new thing under the sun." But there are a great many things learned by experience that are of considerable benefit to younger students and mechanics.

We often hear the remark, by experienced men in the shop: "Why, I see lots of things in that paper about my business that I knew twenty years ago; I don't see anything new in that and never thought anyone would think of writing about such a simple thing."

The good man forgets that while many of these things are not new to *him*, there are hundreds of young men in the business to whom they *are* new, and who gladly avail themselves of the opportunity thus afforded to obtain new ideas. The articles were not written for the older men who *know*, but for the younger men who do *not* know.

The older and more experienced man might as well say to the younger, "What is the use of studying school books? We knew all about the subjects in them years ago." Certainly. But there are thousands of young persons who do not know these things and must learn them. The school teacher might as well say: "Everybody knows the things I teach, why should I go on teaching the same things year after year?" Simply because *everyone* does not know these things.

It would seem to be the duty of those who have, through education and experience, learned of these special matters pertaining to their business or profession, to "pass along" the information to the many younger persons who have not had their experience, and to many who have not had their opportunities.

And it would seem to be a most worthy ambition on the part of the editors of mechanical papers to try to teach practical subjects to young mechanics and thus extend "the greatest good to the greatest number," as well as to record the new inventions and discoveries, and to publish wise dissertations on deep and erudite scientific subjects.

OSCAR E. PERRIGO.

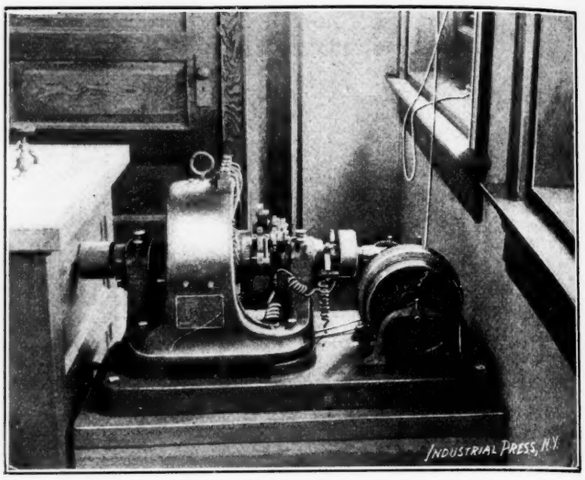
AN AUTOMATIC ELECTRIC CURTAIN HOIST.

Editor MACHINERY:

In every college lecture room as well as in many high schools and institutes the electric stereopticon is frequently employed in connection with the regular day courses of work. It is then necessary to darken the windows by means of shades, as well as to draw down a prepared white screen for illustrative purposes.

The accompanying illustration shows a very unique electrical hoisting apparatus which is used for drawing down the shades and the stereopticon screen at the same time by simply pressing a button or turning a switch. The apparatus was devised by Chas. W. Carman, of Chicago, formerly the professor of physics at the Lewis Institute.

This automatic electrical device makes it possible for the operator at the lantern to open all the opaque shades of the lecture room or laboratory in an instant by a special switch close at hand. The same device raises the screen out of the way while another daylight demonstration or lecture is taking up a portion of the time. The curtains are all raised or lowered in less than half a minute from the time the switch is closed, and when fully opened or closed the mechanism is automatically cut out of circuit. The operator after manipulating the switch may therefore immediately give his attention to other work.



Electric Curtain and Screen Hoist.

The drum is connected to the motor through a worm gear and a magnetic clutch. It is a reversible motor and by means of a double-throw switch is operated in one direction or the other, depending upon whether the curtains are to be raised or lowered. The limit stop provided breaks the circuit through the motor armature and the magnetic clutch, and changes the connections when the curtains are in their extreme position. The magnetic clutch ceases to act and the curtains are held in position while the armature comes to rest after its momentum is overcome.

The stereopticon screen is connected to the drum by a rope and the various shades about the room are connected by cords through pulleys to the rope which extends around the room below the windows. A weight is arranged at the end of the rope which keeps it taut regardless of the action of the curtain rollers. There are two portions on the drum, one of greater diameter than the other, and the curtain roller cords are connected to one and the stereopticon screen rope to the other so as to provide for the different ranges of travel. The motor used is of the multipolar direct current type, as noted in the accompanying view.

Buffalo, N. Y. FRANK C. PERKINS.

TOOLS FOR MACHINING A SPECIAL CASTING.

Editor MACHINERY:

The hood-shaped casting shown in Fig. 1 formed part of an electrical appliance which was being manufactured in

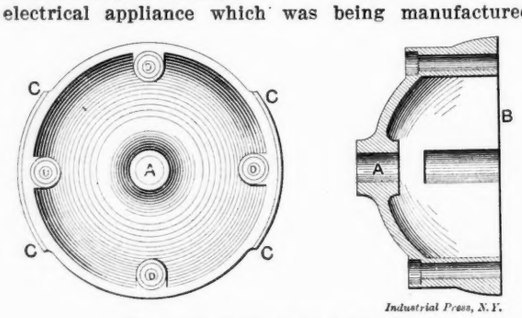


Fig. 1. The Casting to be Machined.

large numbers and, as it is a characteristic piece of duplicate work, the method employed in its production may prove of interest to MACHINERY readers.

The operations necessary for machining this casting were:

First, to drill and ream the ½-inch hole *A;* second, face the base *B;* third, finish the circular portions *C C* to given diameter and taper; and finally, to drill the ¼-inch holes through the center of each of the four posts *D D*. The first and second operations were both performed on a turret lathe with the casting held in a four-jaw chuck, as shown in Fig. 2. The hole *A* was first bored with the usual turret boring tool and reamed to size with a floating reamer. The work was then driven slowly, by throwing in the back gears; and the

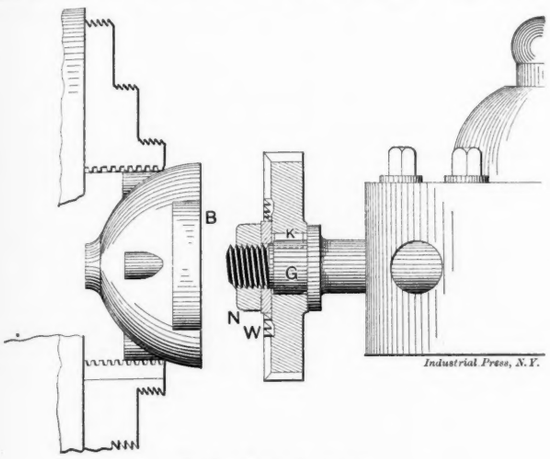


Fig. 2. Facing the Base.

second operation, that of facing the base *B*, was performed by the use of a large face milling cutter, placed on an arbor which was held in the turret head, as shown in Fig. 2. This cutter was of the ordinary type of facing cutter except that the teeth, on the facing side, were staggered to prevent chatter. The cutter, which was driven by the key *K*, was held in place on the arbor by the nut *N* and the washer *W*.

With this cutter it was possible to machine a large number of castings before it required to be ground.

The third operation, that of finishing the circular taper surfaces *C C*, was accomplished as shown in Fig. 3 by the use of an end mill in a universal milling machine. The work was held on an arbor between the tail and dividing-head centers and the swivel carriage moved around until the table and arbor stood at the desired angle with the face of the milling cutter. After setting the work so that the desired amount of stock would be removed, the cross-feed screw was clamped, and the work fed against the cutter by revolv-

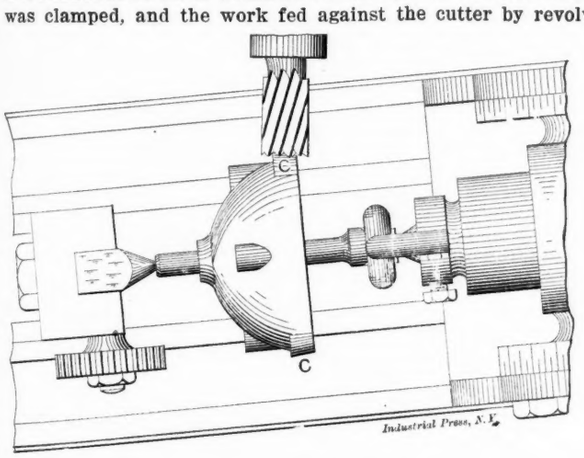


Fig. 3. Milling the Sides.

ing the dividing head by hand. For the last operation, that of drilling the holes *D D*, the jig shown in Fig. 4 was constructed. This jig was made in two parts, a body casting in which the work was located, and a lid *W*, which was hinged at one side and carried the four tool-steel bushings *R R* by means of which the holes were located and drilled.

A hinged bolt and thumb nut *Q* served to clamp the two parts together when the jig was in use.

The bottom of the body was bored out to correspond in taper and diameter with the taper surfaces of the work at *C C*. Extending inward from one side of this hole was a lug *K* in which was fitted the stop pin *Z*. The stem of this pin, where it fitted into the lug, was eccentric with the body of the pin so as to provide for adjustment, while the screw *J* locked the pin in place when the proper adjustment was attained.

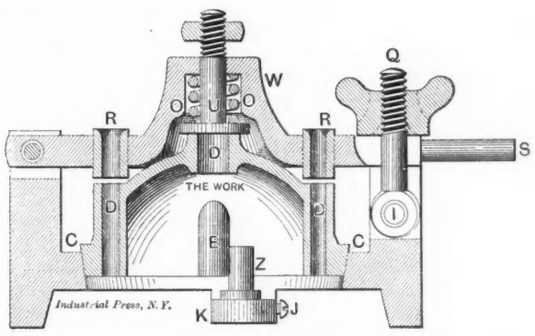


Fig. 4. Jig for Drilling.

This pin was brought against one of the inner lugs of the casting, as at *E*, and thus located the lugs in the proper position to be drilled.

When in use the swinging clamp *Q* is released and the lid *W* thrown back. The work is then slipped into the body and located within the taper seat and against the stop pin *Z*. The lid is then brought down by grasping the handle *S*, and as the spring pad *U* strikes the work the tension of the spring *O O* enables it to force it tightly down on the locating seat. The lid is then held down on the body casting with one hand, while the swinging clamp is swung up and fastened with the other. The casting is then drilled through the bushings *R R*. One of the best features of the jig is the impossibility of the chips and dirt interfering with the accurate and positive locating of the work.

FRED J. BRYON.

Brooklyn, N. Y.

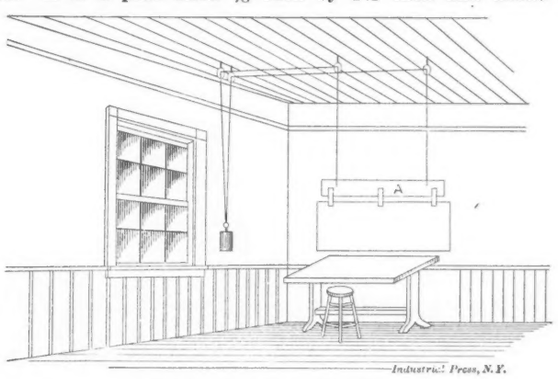
A DRAFTING-ROOM CONVENIENCE.

Editor MACHINERY:

How often it is that a draftsman is required to use another drawing for reference which he must continually consult, and if it is a large sized drawing it is generally kept on the consulting table beside his drawing board. This compels him to keep forever stretching to see it or constantly getting on and off his stool.

In a place where I was once employed, having much of this to do, I devised a scheme which caused some ridiculing from the boys, but which proved to be very useful as well as cheap, and it may prove of interest to some other draftsman.

The illustration will make it clear without much explanation. *A* is a pine stick ⅜ inch by 1½ inch and about 40



Hanger for Reference Drawings.

inches long. Onto this stick are screwed three ordinary spring clothes pins. Two strings are fastened to the stick and pass up to two screw eyes placed in the ceiling the same distance apart as the strings on the stick.

Two more screw eyes are placed in the ceiling near the wall, or any out-of-the-way place, and through these the strings pass down to a weight. This holder is placed parallel to the drawing board about one inch back of it.

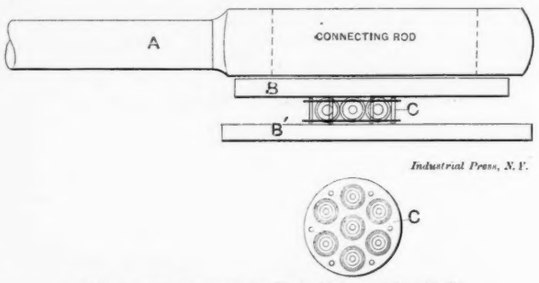
This holds the drawing where it can be easily referred to by the draftsman, and it can be easily raised or lowered to suit his convenience.

ERNEST W. DUSTON.

BALL BEARING FOR SUPPORTING LONG WORK ON A SLOTTER.

Editor MACHINERY:

Recently while passing through the shops of a large concern in Philadelphia that builds blowing and high-speed engines, I noticed an application of the ball bearing to a rather unusual purpose and one that was new to me. Like many other simple things its use for the purpose is quite obvious when it is once known.



Ball Bearing Support for End of Connecting Rod.

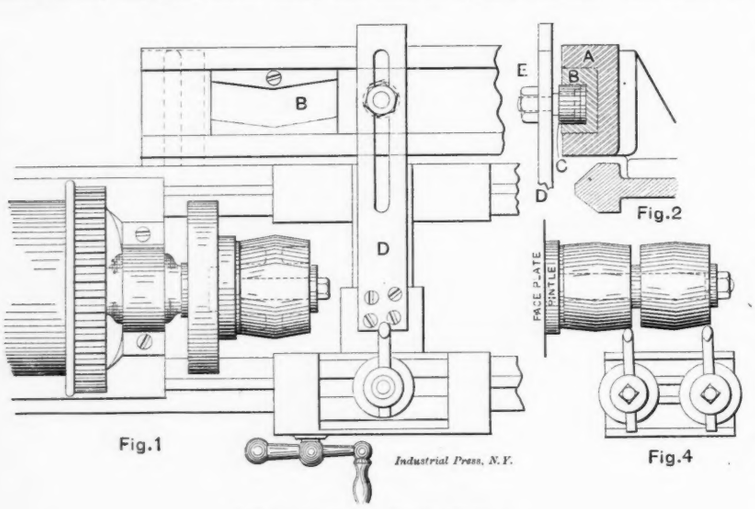
A large connecting-rod was being machined on a slotter and the ball bearing was used to support the outer end so that it was free to move in all directions with the feeds. The usual plan that I have seen followed in such cases, is to support the outer end of a long piece by a rope tackle or a chain hoist attached to an overhead support, but in some cases, as here, such an arrangement is inconvenient. The connecting-rod on the slotter was of the solid-end type, 12 or 15 feet long and weighing probably not less than 1,500 pounds. The work being done was squaring up the interior surfaces for the adjustable brasses so that the feeds were in two directions. If a roller bearing or a carriage with wheels had been used it would have been necessary to turn it one-quarter around when changing from one feed to the other. The ball bearing *C* was placed between two surface plates *B B'* under the rod *A*, as indicated in the cut. The balls were about 1½ inch diameter and were six or seven in number. They were held in a cage made of two disks of sheet iron held in proper relative position by rivets and distance pieces. The disks were, of course, perforated with holes through which the balls projected in order to bear on the plates.

Newark, N. J. F. EMERSON.

TURNING PULLEYS IN THE LATHE.

Editor MACHINERY:

Considering the large number of excellent machines that are now made for turning pulleys it may seem a little behind the times to say anything about doing this class of work in lathes.



Lathe arranged for Turning Pulleys.

There are, however, many shops in which a large number of pulleys have to be turned, yet not enough to warrant the installation of an expensive pulley turning machine. In such shops the pulleys are turned in a lathe, the tail stock being set over to give the taper which is required to give the pulley its crown.

As this involves several objectionable features, a number of expedients have been devised whereby the pulley may be turned crowning, at the same time keeping the centers in line.

The method here described has been in use for about six years and has been very satisfactory as it is extremely simple and does the work rapidly.

A grooved rail, *A*, Fig. 2, is fastened onto the back of the lathe bed and in this groove slides the guide block *B*, in which are cut two grooves making the same angle with the center line of the lathe as it is desired that the faces of the pulley shall make with the axis. In this groove runs a roller *C*, which is fastened to the under side of the arm *D*. This arm *D* is in turn attached to the tool block. The cross feed screw is removed from the carriage so that the motion of the

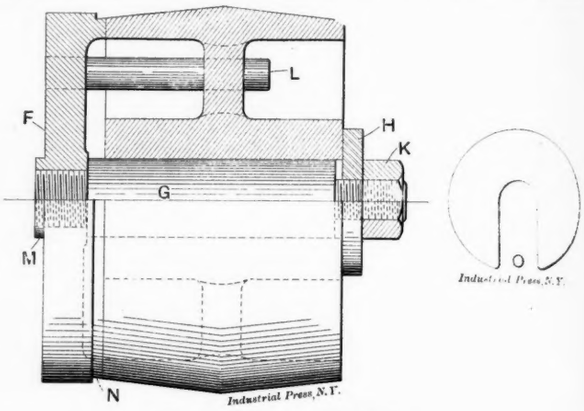


Fig. 3. Pintle for Turning Pulleys.

roller in the guide block imparts a similar motion to the tool in the tool post. The guide block *B* is clamped within the rail *A*, in such a position that when the tool is at the point of the crown of the pulley the roll will be at the apex of the groove. The tool is set by moving the tool block in and out, with the nut *E* loose, allowing the shank of the roll to slide freely through the slot in the arm *D*. The tool and guide block having been set properly, are clamped in their respective positions, and the pulley is turned in the same manner as if the face were straight. When this attachment was used to turn pulleys that had been forced on an ordinary lathe arbor it was necessary to alter the guide block for each pulley in order to bring the center of the crown coincident with the center of the pulley; so for the stock sizes of pulleys, the faceplate arbors, or pintles, were made as shown in Fig. 3. These pintles consisted of a cast iron base *F* into which was securely screwed the arbor *G*, of the same diameter as the bore of the pulley. The pulleys were held on the arbor by the washer *H* and the nut *K*, and were driven by means of the pin *L* which engaged one of the arms. The nut *K* is of such size that the distance across its corners is less than the bore of the pulley and the washer *H* has one side open at *O*. By making the nut and washer in this way, when it is desired to remove a pulley, the nut is turned only enough to release the washer which can be slipped off by the slot *O*, after which the pulley can be pulled off over the nut.

The pintles were held to the faceplate by two clamp bolts and were centered by the boss *M*, which fits a corresponding recess in the center of the faceplate. A little step will be noticed on the rim of the pintle at *N*. This is for setting the lathe tool and is of the same diameter as the pulley to be turned will be at the edge of the rim. This is of the greatest convenience, for in using this attachment the cut always begins at the outside edge of the pulley, and if we did not have this gage it would be necessary to calculate each time what the diameter should be at the edge in order that the pulley should have the required diameter at the crown. As it is, we have only to set our tool to the gage and

we know that the pulley will have the proper crown diameter. A separate pintle must, of course, be provided for each diameter and face of pulley.

To turn a pulley with this attachment, we first set the tool to the gage on the pintle, then the carriage is run by hand, away from the pintle sufficiently to allow the pulley to be put on. After this the tool is run up to the edge of the pulley, the longitudinal feed is thrown in, and the pulley is turned, the tool feeding toward the headstock. When the turning is completed, the lathe is stopped and the pulley taken off. The carriage is then run back out of the way and the next pulley put on the pintle, the carriage brought up to the starting point, and the operation repeated. The tool having once been set for a given size need not be altered except for sharpening.

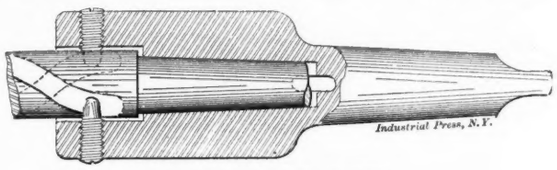
Two small pulleys may be turned at the same time by using two tools as shown in Fig. 4.

New York, N. Y. GEORGE HENRY.

HOLDER FOR BROKEN SHANK DRILLS.

Editor MACHINERY:

Like most tool-makers, I have had a great amount of trouble in trying to use drills from which the tang has been broken. These drills are too good to throw away, so I devised the socket shown in the sketch for holding them. The taper shank of the drill fits its corresponding taper hole in the socket and is thus sure of running true. After the drill is



Holder for Broken Shank Drills.

pushed into the socket the headless set-screws are screwed down into the flutes of the drill and thus keep it from turning in the socket. This arrangement works very satisfactorily and soon saves its cost in the value of the otherwise useless drills that can be used with it.

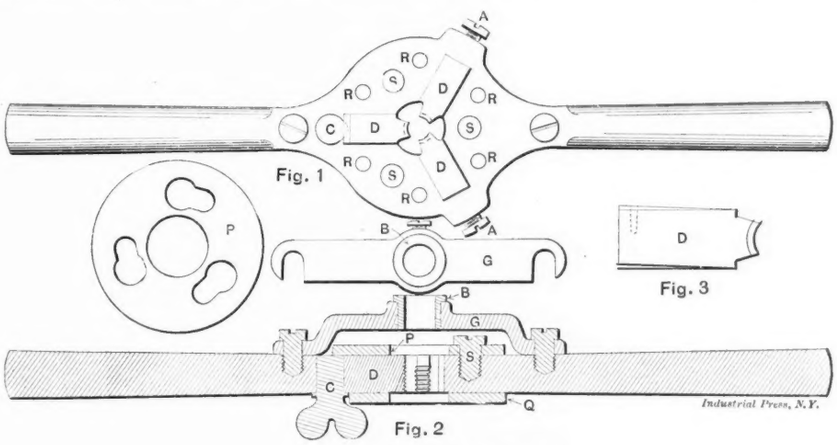
Philadelphia, Pa. FRED HARRISON.

AN ADJUSTABLE HAND THREADING DIE.

Editor MACHINERY:

The accompanying sketch shows a hand threading die, the cutters of which are backed off slightly, making it a very easy running die, and it is also provided with a way of opening the cutters to back it off of the thread that has been cut and closing them again to exactly the same size.

The stock with plate *P* removed is shown in Fig. 1 and a sectional view with all parts in position in Fig. 2.



Hand Threading Die and Die Stock.

The plate *Q* is firmly riveted to the stock by the six rivets marked *R*. The plate *P* drops over the heads of the three screws marked *S*, and after turning the narrow part of slots under these heads the screws are run down and hold the plate in position.

The cutters *D D D* are made to fit the slots in the stock, are threaded, and then tapered off on the cutting side as shown in Fig. 3 (a taper of about .006" per inch) and a thin piece of steel riveted to the opposite side with a small rivet and worked down until the cutter and wedge is the size the cutter originally was.

This throws the cutting edge in enough so that the thread following does not drag or bind on the work.

The cam *C* has a flat side and when the die is to be backed off of a thread its flat side is turned to the cutter, allowing the cutter to slide back enough for the die to run freely off the threaded bolt. It is kept in place by a small screw (not shown), the head of which is seated on the small collar beneath the butterfly head.

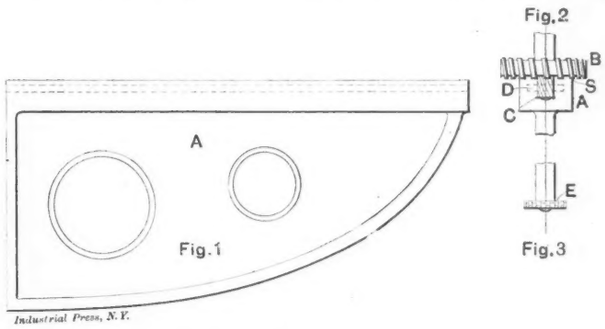
The adjusting screws *A A* are to adjust the other two cutters and need not be moved except when sizing the first thread cut. The guide *G* with its bushing *B* is plainly shown and, I think, needs no explanation. M. H. BALL.

Watervliet, N. Y.

A PROFITABLE OPERATION.

Editor MACHINERY:

The tail piece casting, *A*, Fig. 1, of the Binsse Machine Tool Co.'s boring mill, has a long undercut groove on the upper side for the feed slide to which the cutter bar is clamped. This groove was formerly machined on the planer, but at considerable trouble and expense on account of the narrowness of the undercut portions. These are squarely



Milling Tail Piece of Boring Mill.

cut for the wings of the feed slide. Anyone having experience in planing under ledges will appreciate the difficulty of producing square accurate work with slim bent planer tools working in a narrow space. These grooves are now milled on a Brown & Sharpe No. 5 vertical milling machine which has been recently installed. They are finished in four operations, two roughing and two finishing cuts. The first operation is indicated in Fig. 2. The milling tool is a compound cutter, consisting of the surfacing cutter *B* and the grooving cutter *C*. Two of these tools are provided, one for roughing and the other for finishing. After the finishing cut has been taken, the undercut portion indicated by the dotted lines *D* is milled with the cutter *E*, Fig. 3. Two of these cutters are also provided for roughing and finishing. These cutters are made with "staggered" teeth, that is, say a tooth is located so as to cut on the upper side of the groove, then the next one on the lower side and so on. The shanks of cutters *E* are made to closely fill the groove previously milled so as to steady them sideways. The work produced in this manner is highly satisfactory, both in quality and cost. F. E. R.

PUNCH AND DIE MAKING.

Editor MACHINERY:

In the September number of MACHINERY Mr. Joseph V. Woodworth had an article describing the construction of a double punch and die. Now with all due respect to Mr. Woodworth, my experience as a toolmaker leads me to take exce-

tion to some parts of his method employed for constructing this die.

Mr. Woodworth states that no great care need be exercised in planing the die, as it is to be ground; but it has been my experience that it is better to plane the die carefully so as to have the top and bottom parallel. I have also found it better to bevel the sides of the die last, for by leaving the edges square it will stand squarely on edge and a surface gage can be used for laying out, which I consider much better than using a try square. In using the try square, if the diemaker tilts the beam of his square the least amount, it places the

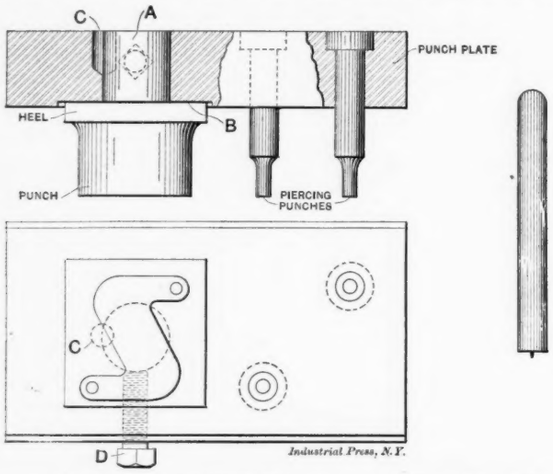


Fig. 1. Punch and Punch Plate.

Fig. 2. Prick Punch.

blade of the square on an angle across the face of the die.

For outlining the blank on the face of the die, he describes the use of a female templet formed by bending a piece of brass over the face of the die and working out the center to exactly fit the male templet. Now in Mr. Woodworth's use of a female templet he introduces several opportunities for an error. In bending his sheet brass to fit the die, an *exact* fit is necessary, and this is not an easy thing to obtain. Then consider the time required for filing an irregular shaped hole to fit a templet perfectly. Supposing that the toolmaker in filing this female templet should get the edges of the profile on a slight angle (such a thing happens quite frequently), then when he scribes the outline on the die from this templet, he is scribing an outline that is not a counterpart of the master templet. Therefore, considering the chances of error in bending, filing and scribing and the time that this requires, I would suggest doing away with the use of the female templet altogether. To do this, clamp a thin parallel—a scale does very nicely—to the face of the die. Against this parallel, place the master templet, clamp and scribe the outline. Then slide the master templet along the parallel to proper position, and transfer the piercing holes directly from it. In transferring these holes, Mr. Woodworth advises the use of a center drill which fits the holes in the male templet. In making the center drill, one turns the drill to fit the hole in the templet and points it at the same time without removing it from the lathe until it is completed. But in filing the clearance of the drill it is a very easy matter to carry the point to one side, making it run eccentric to the body of the drill. True, it will spot a hole central with the drill but the eccentric motion has a strong tendency to crawl along the face of the die, thereby changing the position of the templet. A greater objection is the undeniable chance of error when starting another drill in the place spotted, for a center drill will not allow spotting deeply, as a long point would touch the die before the body entered the templet. I very much prefer to use a piece that has been turned to fit the templet and a very small prick punch turned in the center, at same turning, as shown in Fig. 2. By placing the prick punch in the templet when it is in proper position and giving it a light tap, it will prick the face of the die sufficiently to "wiggle up," as toolmakers term it, with the center indicator.

As to the punch, Mr. Woodworth advocates machining it "so that its entire length will be the shape of the blank." I think it is much better to make it as shown in Fig. 1, the reason being that the shoulder or heel left on the punch tends to keep all the weak parts from spreading during the process of hardening. I submit the following method for aligning the punch and die as an improvement on that described by Mr. Woodworth:

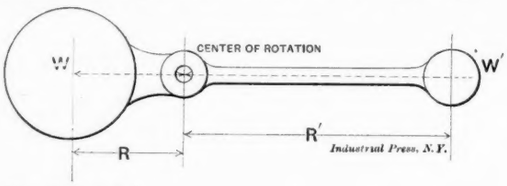
Clamp the punch plate on the face of the die and with the prick punch, shown in Fig. 2, which fits perfectly the piercing holes in the die, prick the face of the punch plate; then without disturbing the plate, scribe the outline of the blanking die upon its face. Remove the punch plate and find the approximate center of the outline scribed from the blanking die and prick punch same. Now "wiggle up" and bore the hole for the shank of the punch *A*, and at the same time face off a seat for the back of the punch at *B*; also bore the holes for the piercing punches. Make these punches as shown to fit tightly the holes in the punch plate. In making the piercing punches they should be left 1-32 inch longer than the blanking punch. Insert the two piercing punches and the blanking punch into the punch plate and fit the dowel *C* in the shank of the blanking punch. Enter the two piercing punches into the die until the face of the blanking punch rests on the face of the die; then scribe the outline of the blanking die on the face of the punch, care being taken to scribe close to the die. Remove the punch and mill as close to the line as possible, return punch to holder after beveling the edges slightly, and shear the punch, being guided by the piercing punches. Work off the stock curled up and repeat the operation until finished. If the punch is to work heavy stock, a setscrew, *D*, against the shank of the punch would be advisable.

New Haven, Conn. FRANK E. SHAILOR.

BALANCING REVOLVING BODIES.

Editor MACHINERY:

Having had several discussions with mechanics of the question of the balance of unsymmetrical bodies, I have found that many have erroneous ideas on the subject. For instance, many contend that a body like that shown in the figure might be in perfect balance at one speed but not at all speeds of rotation, owing to the action of centrifugal force. I trust that the following discussion from a mathematical standpoint may help some to get the correct view of the subject.



In the figure let

W = number of pounds in larger weight.

R = number of inches from center of gravity of W to center of rotation.

W^1 = number of pounds in smaller weight.

R^1 = number of inches from center of gravity of W^1 to center of rotation.

For W and W^1 to balance each other, it is obvious that WR must equal W^1R^1, when they are at rest. Now let:

F = centrifugal force in pounds set up by W when revolving at n revolutions per second.

F′ = centrifugal force in pounds set up by W′ when revolving at n revolutions per second.

Then, of the revolving bodies balance F = F′; also

$$F = \frac{4\pi^2 W n^2 R}{g} \text{ and } F^1 = \frac{4\pi^2 W^1 n^2 R^1}{g}$$

Therefore,

$$\frac{4\pi^2 W n^2 R}{g} = \frac{4\pi^2 W^1 n^2 R^1}{g}$$

and cancelling the equal terms we find $WR = W^1R^1$. So we see that a perfect standing balance is a perfect running balance at all speeds, for the weight on one side multiplied by its radius always equals the weight on the other side multiplied by its radius and the speed factor drops out entirely.

It will be seen from the foregoing equations that the centrifugal force varies as the square of the speed; hence if the speed is doubled the centrifugal force is increased four times.

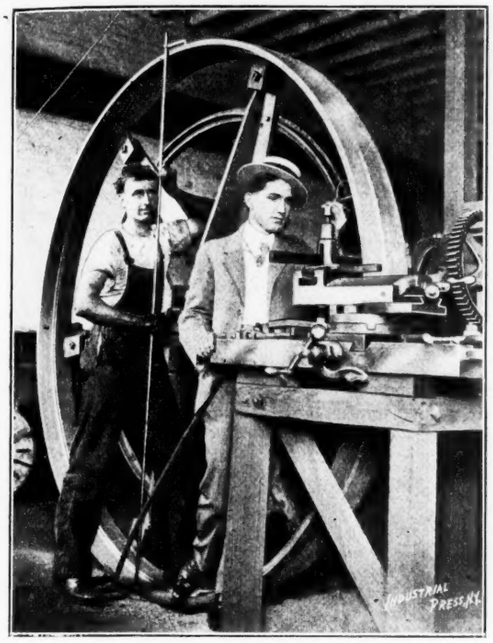
If we suppose the difference between the centrifugal force of W and W^1 to be very slight, when revolving at 100 revolutions per minute they would appear to balance. If now they were revolved 500 revolutions they would at once be seen to be out of balance, since the difference in centrifugal force would be 25 times as great as at the former speed.

Grand Rapids, Mich. G. E. MILES.

TURNING NINETY-INCH PISTON RINGS.

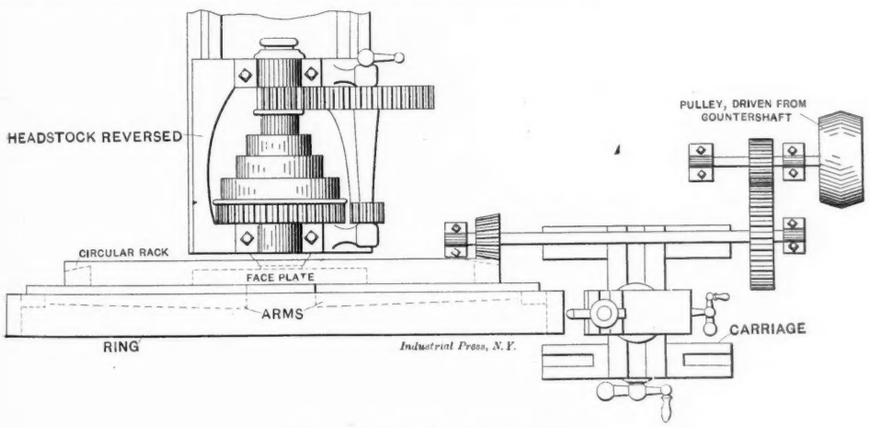
Editor MACHINERY:

In the works where I am employed we recently had occasion to re-bore a compress cylinder 90 inches in diameter and make new rings for the same. The re-boring was easily accomplished



Turning the Rings.

with a 6-inch bar pulled with a rack, but when it came to turning the rings we were somewhat puzzled, as the largest lathe in the shop would swing but 32 inches. The manner in which we finally accomplished the job will be clearly seen in the accompanying photograph and sketch. We reversed the headstock of the lathe so that the faceplate would overhang the end of the bed and to the faceplate we bolted six ribs or arms. Near the outer end of these arms and concentric



Arrangement for Driving the Casting.

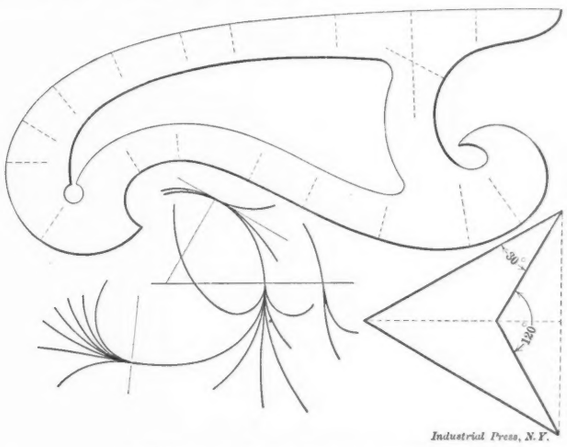
with the center of the lathe we bolted a circular rack. The rings were cast with six lugs which were bolted to the ends of the ribs. The ring was driven by a gear and pinion arrangement clearly shown in the sketch. The carriage was mounted upon a wooden frame and the tool fed by hand. With this rig we were able to turn two rings, each 3 inches wide and 90¼ inches in diameter, in 30 hours.

Dallas, Texas. OTTO P. DOWNING.

DRAWING COMPOUND CURVES.

Editor MACHINERY:

In making up double curves or reverse curves by means of compasses, or the so-called "French curve" templets, it must be remembered, that no two curves can join neatly except at points where their tangents are common, and that any two or more curves can be joined end to end gracefully, if they be tangent to the same line. This is true of two or more convex or of two or more concave curves, or of one or more convex and one or more concave.



Compound Curves and Isometric Triangle.

To facilitate this work it is well to draw at various points on the templets, lines perpendicular to the tangents thereto and in laying down compound curves to see to it that these perpendiculars coincide.

I send herewith an outline of such a templet with some perpendiculars marked thereon; also some "traces" made in accordance with this system.

Machine frames made with outlines which do not sweep into each other on this plan will be neither so strong nor so graceful as where the curves have common tangents at their points of meeting.

As in isometric drawing the main axes which are not vertical are at 30 degrees to the horizontal, there may be used to advantage to facilitate rapid drawing in of the inclined lines such an "arrow-head" device as is shown in sketch. From the base of an equilateral triangle (preferably of transparent celluloid) there is cut out an isosceles one of 120 degrees apex, care being taken to keep the sides of the large triangle equal. The piece cut out may also be finished and used for angles of 30 degrees.

Another way of making the same thing is to cut two equal isosceles triangles of 120 degrees, glue them together at the short sides, and strengthen the joint with a double dovetail or double clover-leaf key.

ROBERT GRIMSHAW.

Hanover, Germany.

GET-AT-ABLE BOILERS.

Editor MACHINERY:

It is a good maxim in any kind of construction that hidden work is apt to be, or become bad. It may start out good, when the maker is competent and honest; but sooner or later if you cannot get at it to inspect it, and repair it, there will be trouble. How few things give out when you can see where they are "going?" Somewhere back or below or within, where the eye cannot reach or where light never penetrates, there is a leak or a crack, or something wrong. A boiler, being an affair which may be highly dangerous, should be of a kind which will permit a man of moderate size not only to look it all over but to go all through it. His eyes should be able to see, his hand to feel every portion. If possible there

should be room for a hammer to strike every part, in order to determine whether it gives a ring or not, and whether or not things are right. The boiler that you can get into, under and around is, other things considered as equal, more desirable than one which cannot be got at. There is a great deal of human nature in mankind, and the average man is not going to break his back and strain and twist his neck and break his shins crawling under and over and by obstructions more or less sharp, hard and dirty. If he owns the boiler, he will do all of this perhaps under a sense of duty to himself; but remembering that, after all, the duty is principally due to himself, he will postpone paying it until the last possible moment. Sometimes he waits until the "last horn blows," and the last horn is an explosion.

Accessibility is a source of economy, because the boiler that can be got at easily will be kept clean, and the clean boiler will make steam more cheaply than a dirty one. The accessible boiler is more safe, other things being equal, than the one which cannot be got at without a great deal of trouble. Eternal vigilance is the price of safety no less than of liberty.

The boiler which can be got at will be less likely than any other to break down suddenly and stop a whole establishment. And in these days the stoppage of steam supply may throw out of work hundreds and even thousands of hands; for steam is not only the source of power, but also the heating agent.

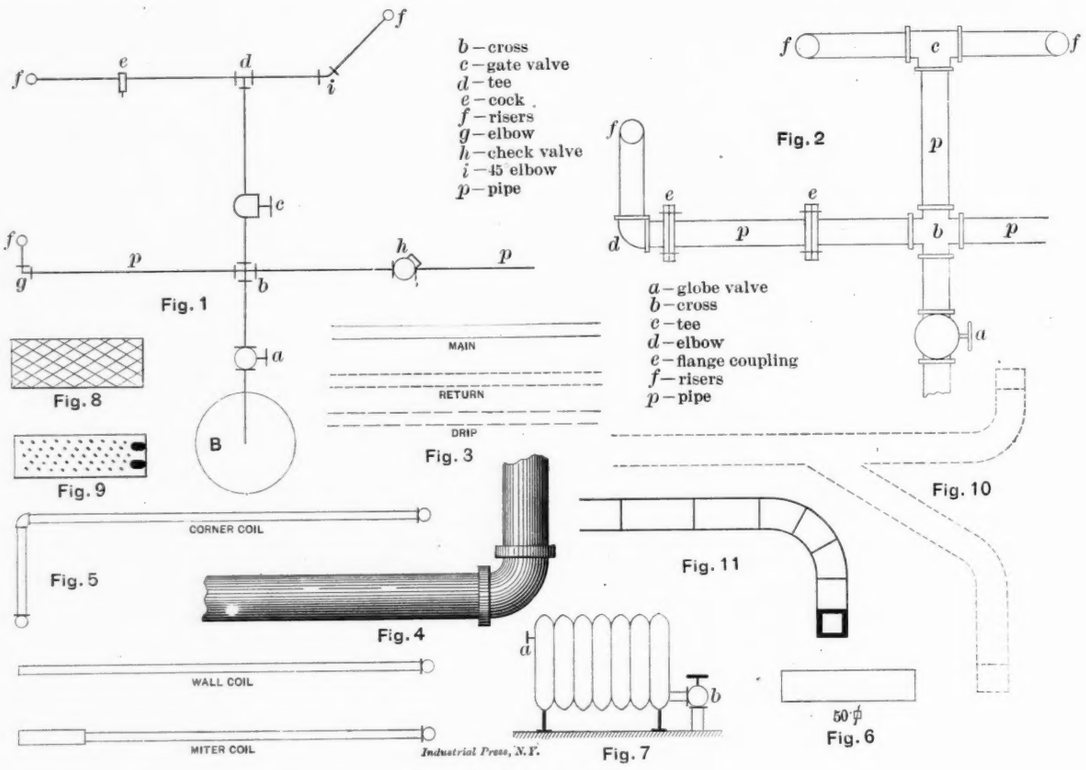
All things being considered, and considered in their true light and in their true weight, it pays in every way to provide in a boiler a fair degree of accessibility; and the boiler which is get-at-able is the one which can be trusted, day in and day out, to give better money's worth and cause less anxiety than the one which offers a premium on neglect. R. E. VERSE.

is made a little thicker or thinner than the plan calls for. In a case like this the waste of time in recutting and threading pipe may amount to as much as the expected profit. Another point to be considered is the height of the various floors; these are frequently different, sometimes on the same floor there is a difference of a few inches in the height. Upper floors have usually more area than the lower floors, due to the thickness of the walls decreasing toward the top. If this is not taken into account a riser that is about 4 inches away from the wall at the first floor may be 12 inches away at the top floor.

The simplest conventional way to represent a piping system is shown in Fig. 1. The pipe is represented by straight lines *p*, the fittings by crossing the former with short lines and by circles or parts of circles.

When it is desired to have the drawing represent a pipe a little better than done in Fig. 1 we may use two lines. In this way the various fittings will, of course, look better, but in the writer's judgment, all this extra labor is in most cases merely time wasted. In Fig. 2 is shown an arrangement of piping in which the pipe is represented by double lines.

Frequently there are three lines of piping, one under the other, or alongside. In the drawing they are shown side by side. These pipes are usually steam, return, and drip. To prevent misunderstanding they may be drawn in different colored inks; say black for steam, red for return, and blue for drip. For blue-printing the use of colors is not recommended, therefore black alone should be used; the steam pipe may be represented by solid lines, the return by dots, and the drip by dashes, as shown in Fig. 3. In every case, however, an index should be given on the drawing.



Conventional Pipes and Fittings.

CONVENTIONAL METHOD OF DRAWING PIPES AND FITTINGS.

Editor MACHINERY:

The drawing of plans for a steam heating system is not usually done in strict accordance with the principles of mechanical drawing. To do so would be a mere waste of time as conventional methods of representing the various pipes and fittings are just as intelligible to the steam fitter as a correct representation would be.

Before commencing the drawing the draftsman should measure the building carefully. It is not safe to rely entirely on the architect's plans of the building, as frequently a wall

A very important point is to see that the size of each length of pipe is distinctly marked.

When a drawing is to be made for "show" the piping may be shaded something like Fig. 4.

Fig. 5 shows conventional ways of representing various coils.

Fig. 6 shows a plan of a radiator; it is merely a small rectangle. The number of square feet of heating surface it is to have should be stated; the symbol given after the 50 (in Fig. 6) stands for "square feet," it is simply a small square with an *f* drawn over it.

Fig. 7 represents an elevation of a radiator, it consists of

a number of vertical lines joined, freehand, at bottom and top so as to represent the various sections. An air valve is shown at *a* and a radiator valve at *b*.

Fig. 8 shows a conventional way of showing a register, Fig. 9 a pin radiator. Figs. 10 and 11 show ways of representing air ducts. Where a riser is to be shown leading up to a register it is merely necessary to make a small rectangle as shown.

Many other conventional methods could be shown but the ones illustrated above are perhaps the best, as they are quite simple.

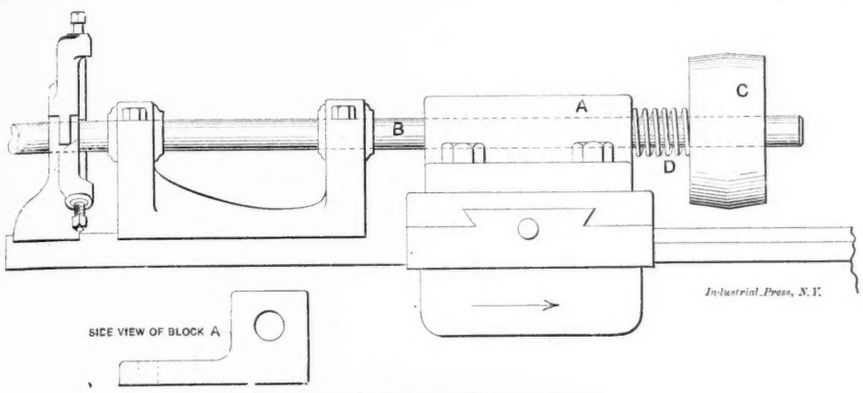
CHARLES G. PEKER.

New York, N. Y.

RE-BORING HEADSTOCK BOXES.

Editor MACHINERY:

In the September MACHINERY, "Connecticut" asks for a method of re-boring headstock boxes. I send the accompanying sketch to show a very simple way in which this may be done.



Arrangement for Re-boring Headstock Boxes.

Before dismantling the lathe, the block *A* is bolted to the tool post and bored out to carry the boring bar *B*. The cross slide gib screws should be set tight to prevent the block from getting out of line after it is bored. The headstock is then dismantled and set forward on the ways sufficiently to allow the steady rest to be placed on the end of the bed as shown. The boring bar is centered in the steady rest and is fed by moving the carriage in the direction indicated. It is driven by the pulley *C* and the spring *D* is provided to keep the bar from jumping in feeding.

C. P.

* * *

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

3. C. Payton.—Will you please inform me whether or not there is a standard for threading steam and gas pipes which gives the number of perfect threads each respective size should have?

A.—We reproduce the following extract from a table of standard wrought iron pipe sizes, published by Morris, Tasker & Co., Philadelphia, and which may also be found in Kent's Mechanical Engineers' Pocket-book.

Nominal size of pipe.	No. of threads per inch.	Length of perfect thread.
⅛	27	.19
¼	18	.29
⅜	18	.30
½	14	.39
¾	14	.40
1	11½	.51
1¼	11½	.54
1½	11½	.55
2	11½	.58
2½	8	.89
3	8	.95
3½	8	1.00
4	8	1.05
4½	8	1.10
5	8	1.16
6	8	1.26

The taper of the thread is ¾ inch per foot for all sizes.

4. W. J. D. I have a plate bearing a series of knives which are about 7-64 inch thick, and from 9-16 to 11-16 inch wide on the end. Both plate and knives are malleable iron. I wish to harden these knives in the shortest time and cheapest way, the case-hardening to extend back about ⅜ inch from the end, the balance of bar and knives to remain soft and the points not to be brittle. Will you advise me as to the best way to do this?

A.—Melt some cyanide of potassium in a crucible or an iron dish. A comparatively shallow dish would answer the purpose. It must, of course, be large enough to receive all the projections. The cyanide must be heated to a red heat. The blades may be immersed in it and left for a sufficient length of time for the cyanide to penetrate to the desired depth. (This must be a matter of experiment, with a scrap of the same metal.) When heating in the cyanide the blade should be worked up and down a trifle, to prevent a fire crack. When heated for the proper length of time it may be removed and plunged in a bath of water. Should this, however, make the metal too brittle, use a bath of sperm oil and tallow—equal quantities. If this does not make them hard enough add alum to the oil until the desired result is obtained; although I should say the bath of water would harden them all right; malleable iron is a variable quantity to consider, as no two foundries turn out a product exactly alike, and no one foundry (so far as I know) turns out a product that runs uniformly right along—if considered from a hardener's point of view. It is best to get a good quality of cyanide, being careful *not* to get one made expressly to produce colors. There is a brand made which, when malleable iron gun frames are heated in it and dipped in water, will produce the most beautiful colors, but will not harden the work. But that is a *special* brand, and is not used for ordinary purposes. Cyanide is a violent poison, and care should be taken not to allow any moisture to get into red hot cyanide, as this would cause it to fly and perhaps severely burn the person using it.

5. Subscriber.—"Kindly state through your columns how a double helical gear (herring-bone gear) is cut, especially how the corners where the angle formed by the meeting of the teeth of the two parts of the gear are worked out so sharp and neat."

A.—If the gear is to be in one piece and the teeth must meet at a sharp corner we know of no other way than to work out the corners by hand. As this entails a great amount of work, several methods are employed in order to avoid the hand

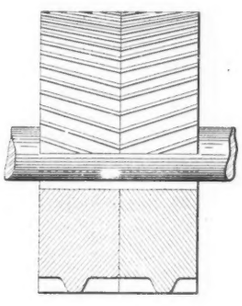


Fig. 1.

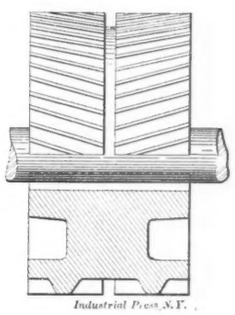


Fig. 2.

work. It is very common practice to use two gears side by side, as shown in Fig. 1. One is cut with a right-hand spiral and the other with a left-hand spiral and they are driven from the shaft by the same key. If thought necessary they can be fastened together by bolts or pins running parallel with the shaft. Another method, which permits of the gear being made in a single piece, is shown in Fig. 2. It consists in omitting a small portion of the teeth where the corner comes, which permits the teeth to be milled in the usual way.

ITEMS OF MECHANICAL INTEREST.

GERMAN GLOBE VALVES—TAP SCREWS IN TAIL SHAFT LINERS—EXPANDING PULLEY—WORM GEARING—RECOIL OF GUNS.

The availability of petroleum as fuel depends on its price relative to that of coal. Roughly speaking, four barrels of petroleum are equal in heating capacity to one ton of good coal. It is quite probable that one pound of petroleum cannot be made to evaporate much more than 16 pounds of water from and at 212 degrees F. The evaporative capacity of one pound of good coal under the best conditions may be safely put at 10 pounds of water from and at 212 degrees F. So the practical calorific value of good bituminous coal may be said to be about five-eighths that of petroleum, pound for pound. A barrel of petroleum weighs, say, 330 pounds, or six barrels to the ton. At $1 per barrel petroleum is no cheaper than coal at $3.75 a ton.

The following note is taken from a recent report of the British Admiralty Committee on Naval Machinery:

Submitted, that for lining bearings, crankpins, bushes and other parts, exclusive of crosshead bushes, the following alloy has, in hard ocean steaming, been found, after extended experience, to give good results: 12 parts tin, 1 part copper, 1 part antimony, mixed in the following way: Six parts tin alloyed with 1 part of antimony, and 6 parts tin with 1 of copper, and the two mixed together. For lining crosshead brasses the following harder alloy has been found to give good results: 85 per cent tin, 5 per cent copper and 10 per cent antimony.

Clear glass is objectionable for the sunny side of a shop having large windows extending to the eaves, or in skylights. The sunlight pouring through on hot days makes a glare and heat that are unendurable. Ground glass is expensive, but a good substitute for it may be easily made by stippling clear glass with white lead and oil. This can best be done by a brush whose bristles are cut off short and square. The bristles of such a brush are dipped into a shallow dish containing the white lead and oil and then struck end on against the glass. Each bristle leaves a small dot of white on the glass that is permanent when once well dried. In this way the light passing through may be broken up without greatly reducing its total volume.

Where steam pipes are carried underground they should, of course, be covered with some insulating material to reduce the losses from condensation, and also as a measure to prevent rapid deterioration by rusting. The general experience of steam-heating companies in cities seems to indicate that the best covering for underground steam pipes is a casing made of white pine having about a 4-inch shell. The casing is built up of staves which have been thoroughly kiln-dried and coated with asphaltum. The lengths should be joined by mortise and tenon joints well made, so as to exclude all moisture. The loss from condensation with such a covering is said to range from 1½ to 6 per cent per mile of pipe of, say, 6-inch size. The loss is, of course, proportionally smaller for larger pipes when the circulation is the same, and greater in both cases when the circulation falls below normal.

The *American Engineer and Railroad Journal* relates two unusual examples of rapid cutting that were recently made at the Bethlehem Steel Company, with Taylor-White steel tools, which well illustrate the phenomenal qualities of that steel. In one instance a cut 1 3-16 in. deep was taken on a nickel-steel electric power house shaft mounted in a 90-in. lathe and revolving for a cutting speed of 25 feet per minute, the rate of feed being 3-16 in. per revolution. In the other, a nickel-steel crank shaft for a protected cruiser was machined in a 50-in. slotter by a cut 1⅛ in. deep and a feed of 1-16 in. per stroke, the cutting speed being 18 feet per minute. The former case corresponds to a removal of 66.78 cu. in. of metal per minute, or 2.318 cubic feet per hour. The great capacity of such rapid cutting can be better appreciated when it is considered that the rate mentioned corresponds to the removal of 1134.9 lbs. of steel per hour, or of 5.67 tons per day of 10 hours steady cutting.

OIL GROOVES IN SHAFTS.

The persistency of an idea that has been instilled by early training, whether in religion or in trade, is quite remarkable to say the least. No trade or avocation is without its traditions and precedents, and it sometimes requires considerable courage to oppose them even if a variant practice is obviously better. One of the most persistent ideas in the machine business is that oil grooves for lubricating bearings should be cut on the inside of the boxes. Probably not one machinist in a hundred ever thinks of cutting them in the shaft, and it is hard to convince the average machinist that such is the best practice. Once in a while some writer in a technical journal will point out that the old practice is inferior to cutting the grooves in the shaft, but it makes little impression and the average machinist goes on in the same old way. It is somewhat refreshing to find a machine tool building concern that follows the shaft-grooving practice for distributing the lubricant and to know that they have been doing it for some years. The Binsse Machine Co. groove all shaft bearings with spiral grooves, usually two in reverse spirals. This is done on short shafts by the milling machine, and the results are eminently satisfactory. There may be other manufacturers following the same practice, but they are not so common as they should be. Let the shaft be its own oil distributor; gravity is too uncertain.

GLOBE VALVES WITH LEVER AND SCALE.

A frequent cause of boiler explosions is the too sudden opening of the throttle, especially where the machine to be served is a "steam-chewer" like a steam hammer.

To prevent this and other annoyances of greater or less magnitude and to enable one to see just how far the valve is open, the globe valves shown in Figs. 1 and 2 have been brought out by a German manufacturer, Dreyer, Rosenkranz & Droop, of Hanover.

This design has also the advantage of rendering the opening and closing of large valves more easy.

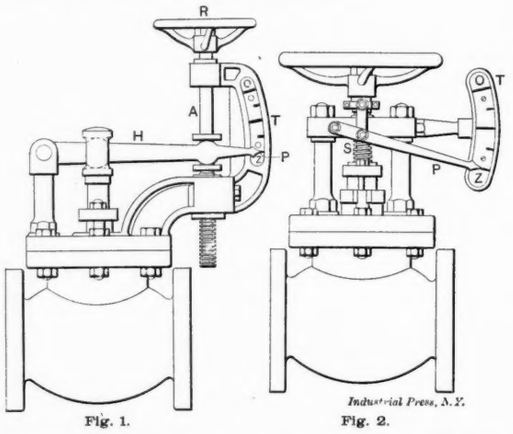


Fig. 1. Fig. 2.

As will be seen in Fig. 1, the stem is not threaded but is a straight, plain rod playing up and down in the stuffing-box.

The work of opening and closing the valve is performed by the screw *A* and its handwheel *R*. Any desired degree of leverage may be gained by proportioning the arms of the lever *H*, and the degree of rapidity of opening and closing is regulated by the pitch of the thread on the spindle *A*.

The position of the double pointer *P* as regards the double-faced scale *T* shows the degree of opening attained.

Fig. 2 shows a valve having double pointer *P* and double-faced scale *T* without the lever.

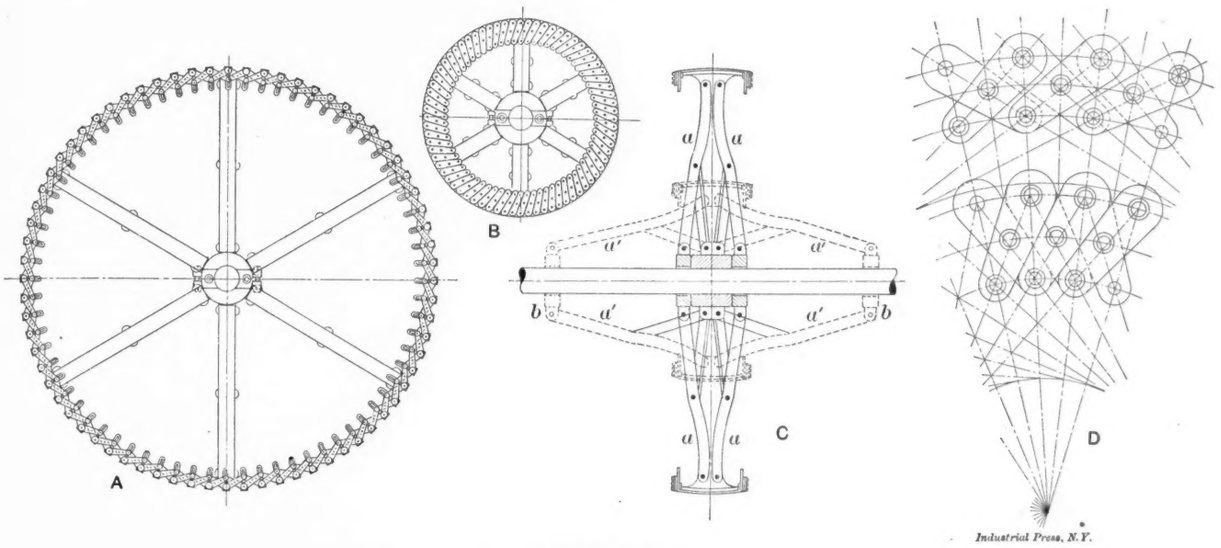
THE USELESSNESS OF TAP SCREWS IN TAIL SHAFT LINERS.

In an article, "Tail Shafting for Marine Engines," which recently appeared in *Marine Engineering*, the writer, Mr. J. P. Badenhausen, quite properly condemns the common practice of putting screws through tail shaft liners to hold them to the shafts. He says tail shaft liners must be made of specially good composition, since the stress set up by shrinking them in place has sometimes been sufficient with common alloy to split a liner from end to end. Notwithstanding the fact

that the liners are shrunk in place, some marine engine builders make it a point to additionally secure such liners by countersunk tap screws. In his opinion this practice is not only unnecessary but is often the cause of great injury to the shaft. If the liner becomes loose so that the screws are the sole dependence for holding the shaft and liner together, great harm may be done, since the liner is loose and salt water will get between it and the shaft and cause corrosion. The liner being held in place by the screws it becomes doubly dangerous, as the corrosion may proceed indefinitely before it is detected. If a liner gets loose the sooner it is known and remedied the better. Again, the holes drilled into a shaft for the screws tend to weaken the shaft and form the starting point of cracks that otherwise would not have been developed.

EXPANDING PULLEY.

The illustrations, *A*, *B*, *C* and *D*, show the principle of a novel expanding pulley made by Delagneaux, of Paris, for varying the speed of automobiles. *A* shows the pulley expanded to its largest diameter, and *B* contracted to its smallest diameter. The ratio of the largest diameter to the smallest diameter is 2⅛ to 1. So if the two pulleys like *A* and *B* were belted together, the variation of speed possible would be about 4.5 to 1. *C* shows how the arms are jointed so as to collapse to the smaller diameters. When the arms are



An Expanding Pulley.

in the position indicated by *a a a a* the pulley is expanded to its largest size; when they are in the position indicated by *a' a' a' a'* it is contracted to the smallest diameter. The principal novelty of construction, however, is the structure of the rim. It is made up of short sections mounted on short levers, which are jointed together in pantagraph form. The upper part of illustration *D* shows the position these levers take when the pulley is expanded; and the lower portion when it is contracted. The same action is also illustrated in the views of the two pulleys *A* and *B*. The obvious advantage of this somewhat complicated structure is that the pulley is always approximately circular in form no matter in what position it is. This produces a smoother action than is possible with the type of expanding pulley having the rim divided into a small number of sections.

WORM GEARING OF HIGH EFFICIENCY.

The *Electrical Review*, in a recent article, gave a short account of some experiments with worm gear transmission which were made by Messrs. Rosling & Fynn, Limited, of Bradford, Yorkshire, England. Starting with an efficiency of 67 per cent, which was considered good only a few years ago, by careful selection of material, design of pitch and thread, and good workmanship, they have been able to produce a worm gear with a reduction of 40:1, having a guaranteed efficiency of 90 per cent, in the case of a 4 H. P. set and 91 per cent in the case of a 10 H. P. set. In both of the above cases the worm wheel ran at a speed of 40 revolutions per minute. The worm wheel is of a special mixture of phosphor bronze and the worm is of tool steel, both accurately ground and polished; they run in an oil bath of ample size, the end thrust being taken up by ball bearings. Messrs. Rosling & Fynn, Limited, have had some of these sets running for over two years, working steadily 8 to 10 hours a day, and so far there are no appreciable signs of wear.

These sets are used to give the required reduction in electrical driving.

RECOIL OF LARGE GUNS.

It is a well-known principle of mechanics that action and reaction are equal and in opposite directions. The momentum of the gun and the shot fired are equal. The boy who has just fired a musket for the first time realizes the truth of the principle although he may not greatly admire it. When the musket becomes a rifled gun weighing 50 to 60 tons, firing a shot weighing a ton or more, the same principle still applies. J. F. Meigs in an article "Ordnance Engineering" in the *Engineering Magazine* illustrates the immensity of some of the forces called into play on a great battleship by a statement of the quick recoil of big guns. He says that one of these guns weighing as much as a fair-sized locomotive, is projected to the rear at a rate of 25 feet per second when fired. The hydraulic recoil plunger brakes stop it in a distance of about 36 inches and powerful springs instantly return it to the firing position. So quick is the movement that the eye usually fails to note it, and devices are used in gun turrets to prevent guns being loaded twice on account of the inability of gunners when in action to tell whether a gun has been fired or not. Nothing, perhaps, gives an idea of the great forces in action so well as the snapping of a 50-ton weight to the rear and back again so quickly that the human eye can scarcely see it.

* * *

The New York *Sun* publishes some interesting figures regarding the capacity of the two mammoth steamships now building at New London, Conn., for the Great Northern Steamship Co. When completed these vessels will ply between Seattle and the Orient and will have a larger capacity than any vessels in the world.

Each vessel has deck room of over five acres, available for carrying freight and can carry over 900,000 bushels of wheat. Taking the average 36-foot car, with a capacity of 60,000 pounds, this would make a railroad train nearly seven miles long. To transport a full mixed cargo of one of these vessels would require 2,500 ordinary railway freight and passenger cars. The vessels will each be 630 feet long, 73½ feet extreme beam, 55 feet 6 inches in depth; have a gross tonnage of about 21,000 and an extreme load displacement of about 38,000 tons.

NEW TOOLS OF THE MONTH.

A RECORD OF NEW TOOLS AND APPLIANCES FOR MACHINE SHOP USE.

The L. S. Starrett Co., Athol, Mass., have recently brought out a test indicator which can be attached to the needle of a surface gage or to any flat or round support up to ⅜ inch in diameter. With the indicator is furnished a holder to go in the tool post of the lathe. The head of the needle has three working points so that the indicator may be used on work in front, above or below it. The gage is graduated to read in thousandths of an inch.

The Whitman & Barnes Mfg. Co., Akron, Ohio, have brought out a wrench which is a combination of a nut and pipe wrench. In general appearance it is similar to an ordinary machinists' wrench except that it has two sets of jaws, one set having the usual flat faces for use on nuts and bolts while the other set is grooved for gripping steam or gas pipes. The lower jaw on the pipe side is mounted on a pivot which enables it to engage or release the pipe in the same manner as an ordinary pipe wrench.

Nutter, Barnes & Co., Boston, Mass., have just placed on the market a new metal cutting off machine and an automatic grinder for sharpening the saws which are used. The machine uses a 13-inch saw ⅛ inch thick, and is capable of cutting iron or steel of any shape up to 4 inches in diameter. The saw and the gear mechanism by which it is driven, are mounted on a slide which has a forward feed, variable from ¼ inch to 1 inch per minute, and a quick return motion. The saw grinder automatically sharpens the 13-inch saws in about six minutes. The teeth are spaced by an accurately cut index having the same number of teeth as the saw.

"YANKEE" ARBOR PRESS.

The screw press shown in the cut is designed for forcing arbors, straightening work, or any of the purposes for which an arbor press is used. It is built by the Wilmarth & Morman Co., Grand Rapids, Mich. The screw has a coarse pitch, is double threaded, and has a handwheel with heavy rim, the inertia of which is utilized to force the arbor tightly into the bore of the work. By the use of this combination as great a driving effect is produced as with a sledge, but without the results so injurious to the ends and centers of the arbors. The inertia of the handwheel is made use of for giving the arbor two or three final impulses after it has been forced down as far as can easily be done by turning the handwheel in the usual manner, the leverage being 47 to 1. The thread is of so coarse a pitch that the screw will never lock on the work, but when turned down quickly on a tight fitting arbor, it will be repelled and turn in the opposite direction. The arrangement of the jaws on the anvil to accommodate different diameters of arbors is very convenient; they open and close in unison so that the work is always central under the screw, and arbors can be readily forced in and out of thin bushings. To straighten shafts, etc., the jaws are opened some distance and the pressure applied centrally between. With one hand on the work and the other on the wheel, the ram may be brought down with an easily gaged force and the work quickly straightened without leaving a mark on it. Hardwood strips are inserted in the bottom, so that when bolted to a lathe bed no damage will be done to the ways, while lugs keep the press forward to prevent arbors from marring the front edge.

Screw Arbor Press.

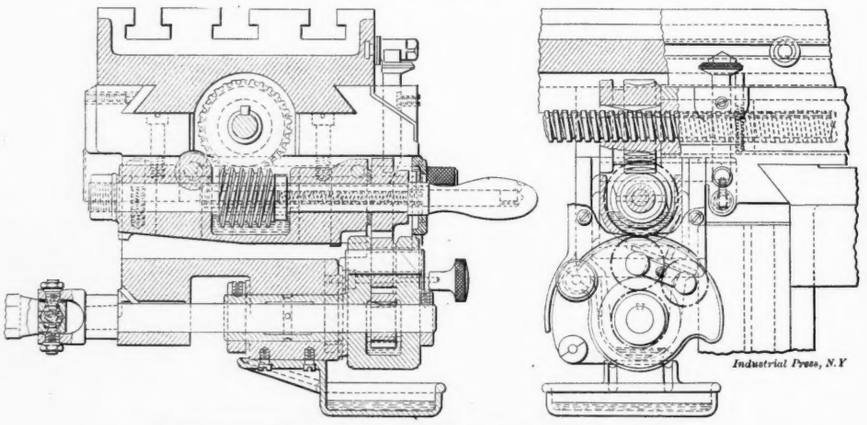


Fig. 2. Section through Feed Mechanism of Garvin Milling Machine.

GARVIN MILLING MACHINE NO. 13½.

Fig. 1 shows one of a new line of plain milling machines made by the Garvin Machine Co., New York, and embodying several recent improvements. The machine is back geared, which enables it to carry heavier cuts and at a faster rate than the usual plain miller and also provides double the number of feed changes. The table is provided with three T-slots and has a quick return, consisting of an internal gear and pinion, that is placed at the end of the slide and is entirely enclosed on all sides. The knee is of the box construction and has extra long in-and-out adjustment. The feed mechanism is shown in Fig. 2. The most direct system of gear

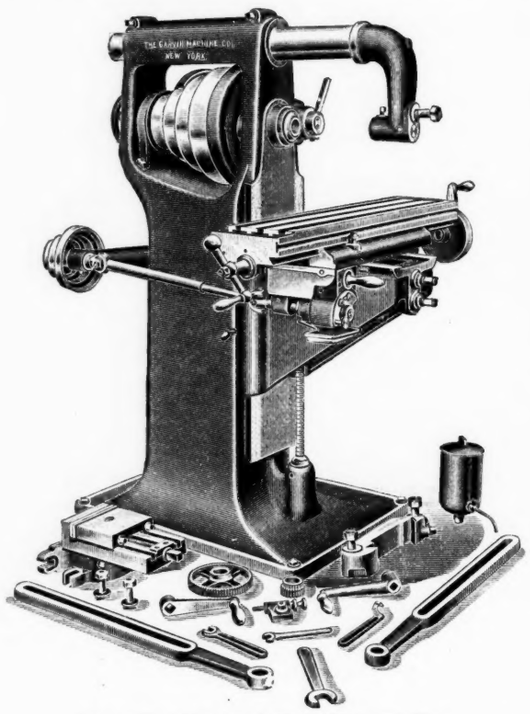
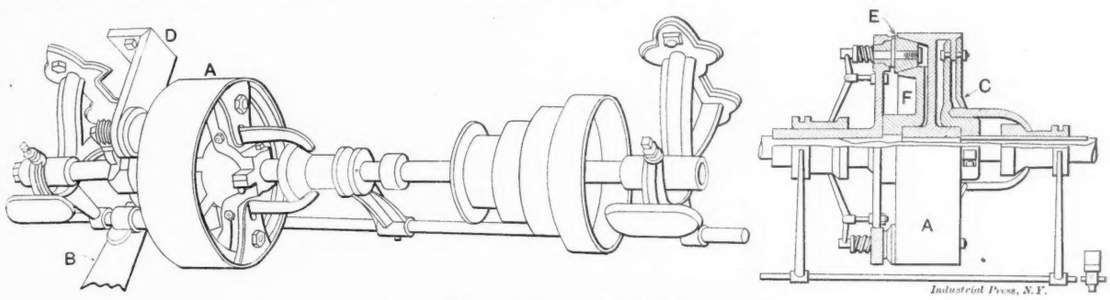


Fig. 1. No. 13 1-2 Garvin Plain Milling Machine.

ing is employed with a minimum number of separate parts so arranged as to respond instantly to the trip under the most severe strain when going in either direction. The drop block, carrying the worm shaft, is in one piece pivoted on a line with the top of the worm. As will be seen in the diagram, this block forms a pocket in which the worm runs in oil both when working and when tripped. The reverse motion is combined in the box and operated by a small knob at the front where most convenient.

The reversing mechanism is of the usual rocker, three-gear type. The rocker is locked in position by a plunger operated by the knob seen in front of the rocker casting and can be thrown over instantly while the machine is running. The trip and latch parts are of the plunger type. The trip button on the side pushes down the vertical plug and this acts by means of an inclined notch to withdraw the horizontal plunger from under the pin, on the side of the drop block, and allows it to fall. A noticeable feature of this machine is the universal joint. This has adjustment for taking up all wear and a center hole in the block, filled with felt, serves as an oil reservoir for the pins.



Friction Reversing Countershaft.

A NEW DRILL COLLET.

Figs. 1 and 2 illustrate a new tool recently patented by A. S. Davis and assigned to the Seneca Falls Mfg. Co., Seneca Falls, N. Y. This tool, which is designed for use in the spindle of upright drills can also be used in lathes and other horizontal spindle machines, for the easy and rapid change of drills, reamers, counterbores, taps, etc., without stopping the machine.

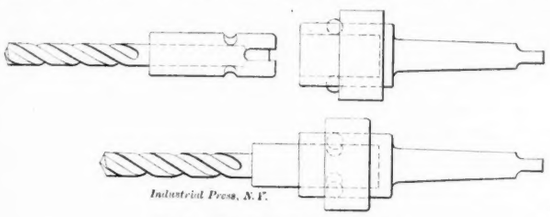


Fig. 1. Chuck, Drill and Collet.

The chuck consists of a socket piece with two steel balls, also a locking ring mounted loosely on the body of the chuck, which may be held in the hand while the chuck is revolving.

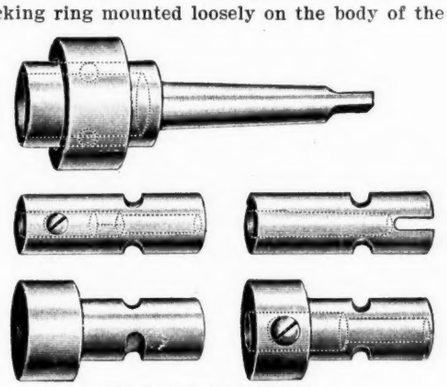


Fig. 2. Chuck and Collets.

The collets are provided with two segmental grooves for receiving the balls which perform the double duty of holding the collets in place and driving same.

To change the collets, it is only necessary to raise the locking ring which instantly releases the balls, allowing the collet to drop out, when another can be inserted, and by dropping (or releasing), the locking ring, the balls roll into place, instantly locking the collet.

It is claimed that owing to the peculiar construction of this chuck, collets can be conveniently and safely changed when machine is running at the highest speed, as there is nothing to catch or shock the operator.

Fig. 1 shows the chuck, collet and drill, both before collet is inserted in chuck and with the collet in place. Fig. 2 shows the chuck and various styles of collets that may be used.

A FRICTION REVERSING COUNTERSHAFT.

The cut illustrates a new countershaft reversing mechanism that has been brought out by Upton & Gilman, Lowell, Mass., for use with lathes and machines of a similar character.

The noticeable feature of this countershaft is, that it is driven by a single belt but may be reversed by the same motion of the shifter that is employed for reversing the ordinary countershaft with open and crossed belts. The use of such a countershaft reduces the amount of driving belt required and also the overhead room occupied. The method by which the reversal is accomplished will be clearly seen by reference to the cut.

The pulley *A* runs loosely on the shaft but by throwing the shifter *B* to one side the friction clutch *C* engages the pulley causing it to drive the shaft in the same direction in which the pulley is revolving. On the opposite side of the pulley is the auxiliary hanger *D*, carrying two or more conical rolls *E*. When the shifter is moved in the reversing direction, these cones are forced between the beveled disk *F* and the bevel on the under side of the rim of the pulley *A*. The introduction of the cones causes the pulley to drive the disk *F* and consequently the shaft, to which it is keyed, in a direction opposite to that in which the pulley is revolving.

Owing to the difference in diameters of the bevel on the pulley and the disk the usual increase of speed is obtained that is desired for quick return.

UNIVERSAL BOX TOOLS.

The accompanying cuts show a universal box tool which has been brought out by the Bayldon Machine & Tool Co., Jersey City, N. J.

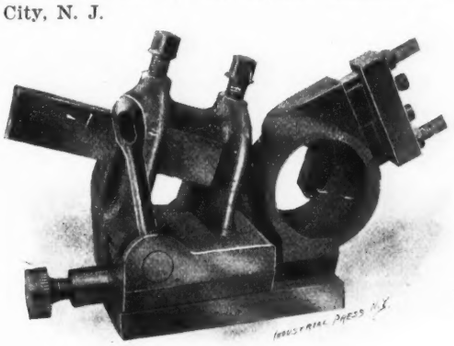


Fig. 1. Universal Box Tool. Back View.

It was originally designed to go with the interchangeable tool posts manufactured by this company, but it is also universal in that it may be used in any turret or bolted directly to the lathe carriage. The steady rest is in two pieces and

adjustment is provided by means of backing-up screws. The tool is held in a gibbed slide by two set screws and an up and down adjustment is obtained by withdrawing the slide from, or pushing it toward, the work. A micrometer screw

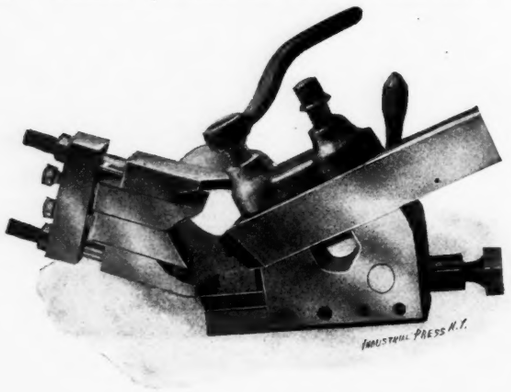


Fig. 2. Universal Box Tool. Front View.

adjusts the tool to cut to size, and a cam, operated by a lever, draws the tool back from the work when the cut is finished.

These tools operate stock up to 2 inches in diameter, and use ordinary lathe tools 1 inch x ½ inch.

EMMERT'S UNIVERSAL VISE.

The Emmert Manufacturing Co., Waynesboro, Pa., have just placed on the market a new universal vise for use of toolmakers, jewelers and metal workers. This vise is universal

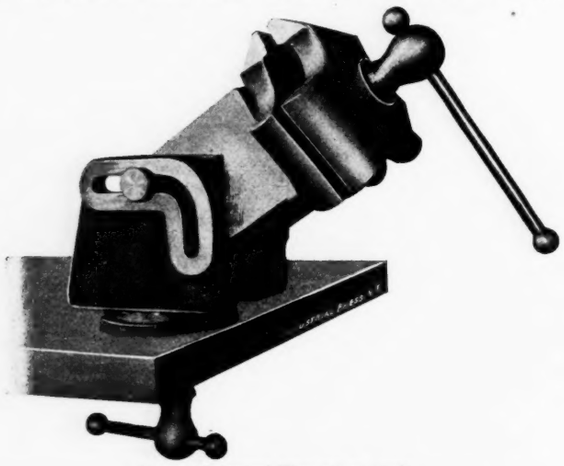


Fig. 1. Universal Vise set at Angle.

in that it can be placed in every conceivable position. As will be seen in Fig. 1, there are three sets of jaws, any one of which can be swung into any position desired for holding

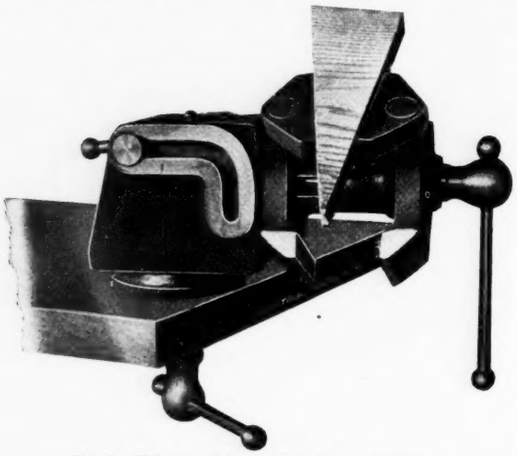
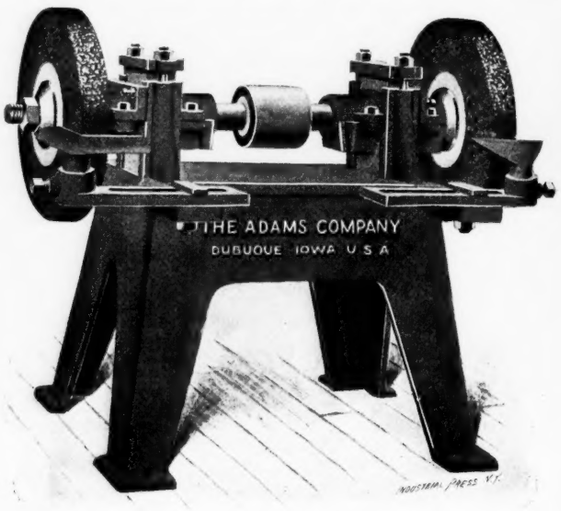


Fig. 2. Universal Vise holding Tapered Work.

work. One set of jaws is made rough for heavy work, another set is smooth for finished work, while the third set is provided with round projections, upon which may be fitted jaws for taper work, round work, copper work, jaws for holding any size of ring, or pipe jaws. All of these styles of jaws are furnished with the vise. Fig. 2 shows the vise with the jaws for holding taper work, in use.

NEW HEAVY GRINDER.

The Adams Co., Dubuque, Iowa, have brought out two new grinding machines, one of which is shown in the engraving. These machines are designated as their No. 1, carrying two wheels 12 inches in diameter, and No. 4, the one illustrated, which carries two wheels up to 24 inches in diameter.

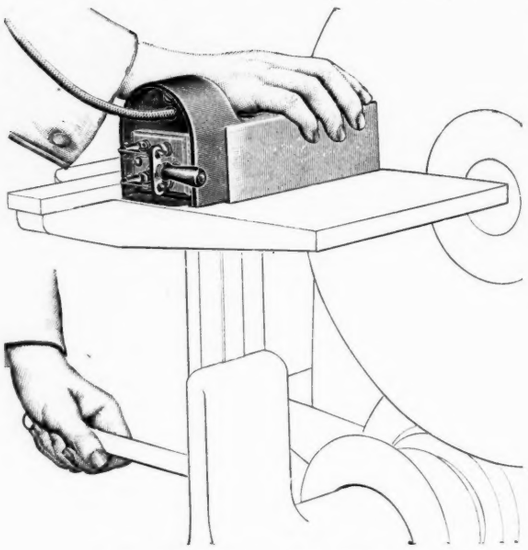


Twenty-four inch Grinder built by Adams Co.

These machines are built for heavy grinding and are provided with long self-oiling bearings which are rendered more serviceable by having the boxes held in position by elastic rubber cushions. The cushioning effect relieves the bearings from the destructive pounding which results from wheels that are running out of true.

MAGNETIC HAND CHUCK.

O. S. Walker & Co., Worcester, Mass., have just brought out the magnetic hand chuck illustrated in the accompanying cut. This chuck is designed for holding pieces of work that are being ground on a disk grinder. It is held by hand as shown

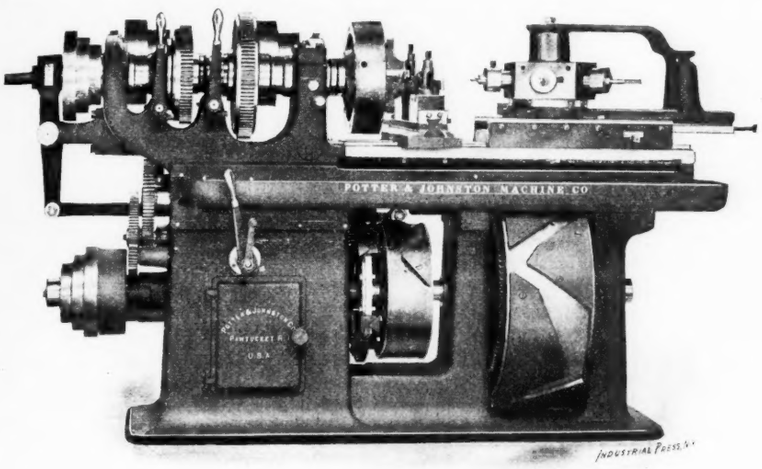


Magnetic Chuck holding Work for Grinding.

in the cut, and is aligned by the squaring bar of the regular swinging rest characteristic of the grinders referred to. The electric connections are made by attaching the chuck to any convenient lamp socket of a 110-volt, direct current circuit.

MANUFACTURING AUTOMATIC CHUCKING MACHINE.

The cut shown herewith represents the latest improved automatic chucking machine which has recently been placed upon the market by the Potter & Johnston Machine Co., Pawtucket, R. I., who were the pioneers in the development of automatic machinery for the production of duplicate parts from castings. The machine is designed and built for the automatic production of all kinds of castings, either cast iron, steel or bronze, up to 10 inches diameter and 6 inches long. It possesses several new features heretofore unknown to this particular class of machinery. The turret has five sides, with 2½ inch holes, and it withdraws, revolves and advances at forty times the feeding speed. The feed is driven and controlled by the spindle. The cross slide can be operated automatically at any time in conjunction with the turret. The turret slide is operated by a large cam drum driven by spur gearing, the power being applied near the periphery of the drum. This arrangement is very substantial and prevents any springing of the working parts. The tool blocks on the cross slide have a travel of 4½ inches in each direction, and have screw adjustment. The standard set of cams furnished with the machine covers all ordinary pieces up to 6 inches in length and requires no adjustment. The automatic back facing attachment shown in cut is a very valuable addition to the machine. This attachment enables the hubs of gears, pulleys, etc., to be finished on both ends at one setting, and in this manner a large variety of pieces which would ordinarily require to be done in two holdings, can be finished complete at one. Another very interesting feature in connection with the machine is the automatic chuck. By the use of this chuck pieces which can be handled with one hand can be placed into the chuck and removed without stopping the spindle. Thus the machine is running all the time and requires very little attention from the operator, hence he can readily run from four to eight machines, according to the class of work being done, making the labor cost of production a very small item in comparison with the increased output thereby obtained. For gripping extra heavy or eccentrically-shaped pieces, a heavy scroll chuck is furnished. A pair of universal turning and facing tools is provided as part of the standard outfit of the machine, and takes care of all ordinary pieces up to 10 inches diameter. The machine is made in three types, viz., machine with geared automatic change speed head, which is the one shown; machine with belt driven change speed head, and machine with plain head. With geared automatic change speed head, the spindle is driven by two trains of gears, each train having four changes of speed; with the belt driven automatic change speed head, the spindle has four changes of speed; with the plain head machine the speed of the spindle is constant, but has four grade cone. The machine is of liberal dimensions, has plenty of power, strength and rigidity; and all working parts are simple and easy of access.



Automatic Chucking Machine.

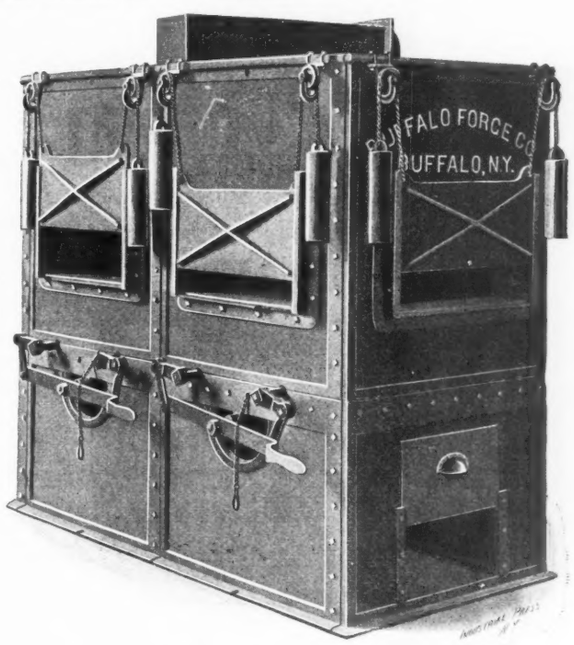
While, of course, automatic chucking machines show up their true value to better advantage when run in groups of, say, half-a-dozen or more, yet if a concern had not a sufficient amount of work to keep several of these going, this machine requires so little attention, that it can easily be run in connection with some other machine, say an engine lathe or a turret machine, and the additional product obtained upon the automatic chucking machine is secured without extra labor cost.

Although this new designed tool has been on the market but a comparatively short time, yet it has been favorably received by the trade, who fully realize the advantages to be gained by the use of such machines. They have already found their way into a number of shops, including the following lines: Textile machinery, printing presses, cream separators, woodworking machinery, pumping machinery, power transmission machinery, electrical machinery, sewing machines, punches, presses, pneumatic hammers, air brakes, etc.

A DOWN-DRAFT FORGE FURNACE.

The accompanying half-tone illustrates a forge furnace recently brought out by the Buffalo Forge Co., Buffalo, N. Y. It is especially adapted for heating work in connection with a steam hammer or similar heavy forging.

A new idea has been introduced in building this forge in sections. Two of these sections are shown in the engraving. In this way the capacity may very easily be increased at any time by installing additional sections. The first or original section is 30 inches long, and each additional section adds 36 inches to the length of the forge, making 66 inches the usual length. Each section is furnished with balanced slide doors on all four sides. When these doors are opened, access may be had to any part of the forge without the least trouble.



Buffalo Down-draft Forge Furnace.

The height from the floor to the top of the grate is 36 inches—the door sills in turn being set slightly above the grate, which is of the improved rocker-grate type 24x66 inches. The cut shows the lever attachment for rocking the grate and removing the ashes, and also the chain which is connected to the air box.

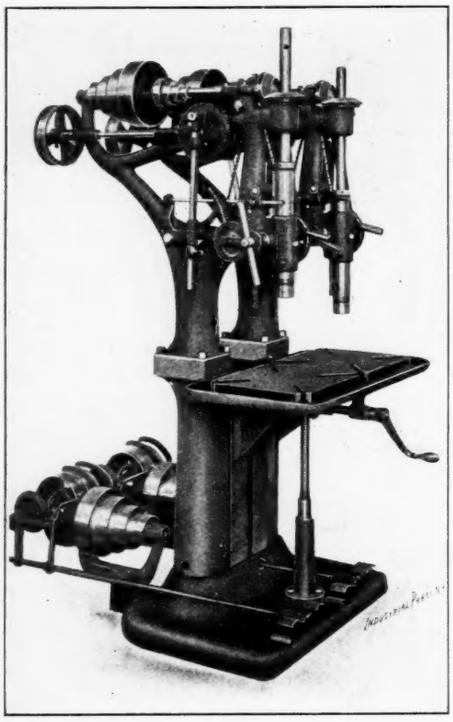
The Buffalo down-draft principle of smoke removal is incorporated in this forge. In the illustration, the stationary exhaust hood is shown at the top of the forge. It carries

away all smoke and exhaust gases, allowing none to escape into the shop. The smoke and gases are immediately and completely withdrawn by down-draft suction through underground tile pipe, there being no escape from even the heaviest fires. This does away with all overhead galvanized iron piping, which is subject to frequent renewal, and always obstructs valuable light and space.

A clean-out door is placed at the bottom of each section, allowing of easy access below the grates. The forge is completely lined with fire-brick, and in the roof there is an additional strip of asbestos. The weight of the forge alone, i.e., the two sections without the brick lining is 5,000 pounds.

NEW MULTIPLE SPINDLE DRILL.

The B. F. Barnes Co., Rockford, Ill., have just placed on the market a new multiple spindle drill which is furnished with two, three, or four spindles as may be desired. It is particularly adapted for rapid work in manufacturing plants where there are duplicate pieces to be drilled. The



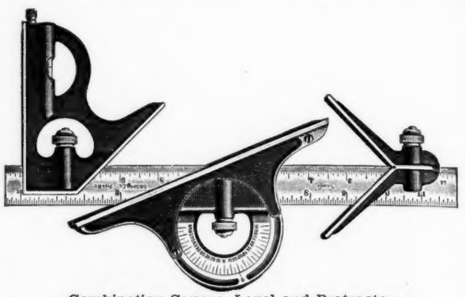
Multiple Spindle Drill.

characteristic feature of this drill is that it requires but one performance of the operator for each complete operation of a spindle; that is, when started the spindles go down to the work, drill through and return automatically. All of the spindles run independently, so that one man can easily operate a four-spindle drill.

This machine will drill to the center of a 19-inch circle. The table has a vertical travel of 14 inches and the spindles a vertical travel of 12 inches. It also has quarter-turn countershafts, and many other special features, as will be seen from the photograph.

A NEW COMBINATION SET.

The Brown & Sharpe Mfg. Co., Providence, R. I., have recently placed on the market the new combination set illustrated in the accompanying cut. This set embodies all the essential features of their combination squares with the addition of the protractor head. As all parts are interchangeable, the head can be used on the same blade as is furnished for the combination squares. The revolving turret is engine divided accurately to 90 degrees either side of the zero line and every care is taken to insure this line being at right angles to the face of the head; this, of course, is very essential to the accuracy of the tool. An important feature that has been added is the indication of a second zero line opposite the one shown at the top of the head. This greatly enhances the utility of the tool, making it more convenient for use in setting work and laying out angles, as many times the zero on the upper part of the head will be nidden by the blade and the other zero can, in such cases, be used to read from.



Combination Square, Level and Protractor.

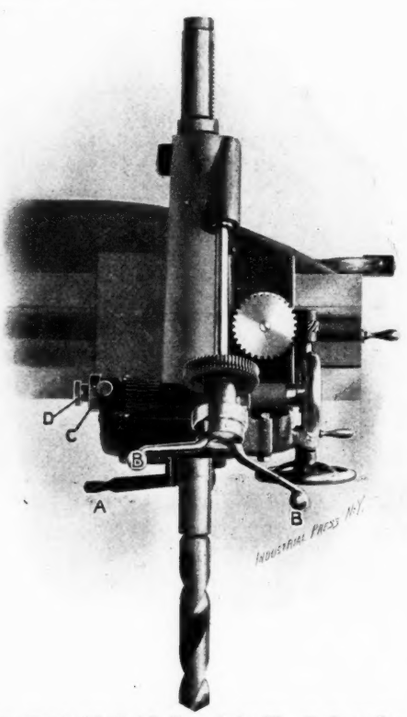
The clamping groove of the blade, instead of being square and having sharp corners, as is usual in tools of this kind, is round. This, beside allowing the rules to be made stronger, also insures the blade being drawn up against the side of the head square with the face when clamping. This form of groove also prevents the accumulation of dirt, as there are no sharp corners, a feature much appreciated in tools of this character.

Each head is furnished with a level, which forms an important adjunct to the protractor head, allowing same to be used as an inclinometer. The level is accurately set for parallelism and after the adjustment is made it is rigidly clamped into position.

Another feature that has been added to these protractors is a reversible head. This allows either side of the tool to be used in transferring angles and avoids, in many instances, the necessity of resetting. The face of the head projects about ½ inch each side of blade, making the face in all about an inch wide. The length of these heads is about 7 inches.

IMPROVED HEAD FOR RADIAL DRILL.

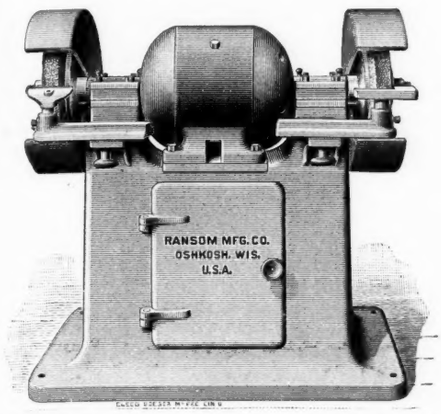
The Wm. E. Gang Co., Cincinnati, Ohio, builders of the five foot radial drill illustrated in the September number of MACHINERY, have perfected a new head and feeding mechanism which they are applying to this drill.



New Head of Radial Drill made by Wm. E. Gang Co.

The feeding mechanism is so designed as to eliminate the necessity of added weight for counter-balancing the spindle. It will be seen that the lower part of head is formed into a

casing which entirely surrounds the driving gears on and near the spindle. Gear covers, not shown in cut, are placed over all other gears. The arm is of the usual oval section, enclosed, with web across the front, and heavily ribbed and braced. Two trains of gears connect spindle with shafts at back of head so that a slight up or down movement of lever *A* gives a slow or fast speed. The spindle gear is placed in the lower



Electrically-driven Emery Grinder made by Ransom Mfg. Co.

part of the head so that power is applied to largest diameter of spindle and close to the work. Ratios of gearing between spindle and shaft at back of arm are 18 and 3¼. All handles are conveniently located and easily and quickly manipulated. The machine is provided with an ample number of spindle speeds and feeds.

BB are handles which, when used as cranks, give means of quickly traversing the spindle in either direction. A light pressure up or down on one or both of these handles instantly connects or disconnects the feed by means of a powerful friction. *C* is a knob, by turning which, any one of the feeds is quickly obtained when the drill is working. The knob *D* operates a friction for disconnecting the feed gears so that when not in use, all these gears and shafts are at rest. The lower handwheel is for traversing the head along the arm by means of spiral gears, rack and pinion, while the upper wheel is for feeding the spindle by hand.

Another improvement that has been made on the drill is to so construct the column that it is raised from its seat onto roller bearings when the arm is revolved.

This machine has successfully tapped 6-inch iron pipe flanges with evidence of considerable power to spare.

RANSOM EMERY GRINDER

The Ransom Mfg. Co., Oshkosh, Wis., have brought out an electrically-driven emery grinder designed to carry two wheels up to 18 inches in diameter. The motor is entirely enclosed and the armature is wound upon a sleeve which is keyed directly to the spindle of the machine. The journals are of cast iron and are provided with ring-oiling devices which supply oil on top of the shaft when the grinder is running.

The motive power is furnished by a 5 H. P. motor, which is capable of carrying an overload of 50 per cent. Careful tests show that to run this machine free with two 18 x 2-inch wheels, 1,200 revolutions, on a 220 volt current, requires ¾ H. P. To run it with one man grinding very hard requires 3 H. P., while with two men pressing as hard as possible 6 H. P. is required. As the motor is capable of 50 per cent overload it will be seen that the power of the motor is sufficient for any load that can be put upon it.

ELECTRICALLY-DRIVEN BOILER TUBE CUTTING MACHINE.

The Bignall & Keeler Mfg. Co., Edwardsville, Ill., have recently made a number of machines illustrated in Figs. 1 and 2, which are used in tube mills for cutting boiler tubes. These machines are designed to cut tubes from 2 inches to 5 inches in diameter, and from 8 feet to 20 feet in length. The bed is provided with two movable carriages, each carriage being equipped with a heavy steady rest, cutting off tools, and reaming lever, the steady rests having interchangeable blocks which are babbitted for the several different sizes of tubes; they thus hold the tube firmly around the greater

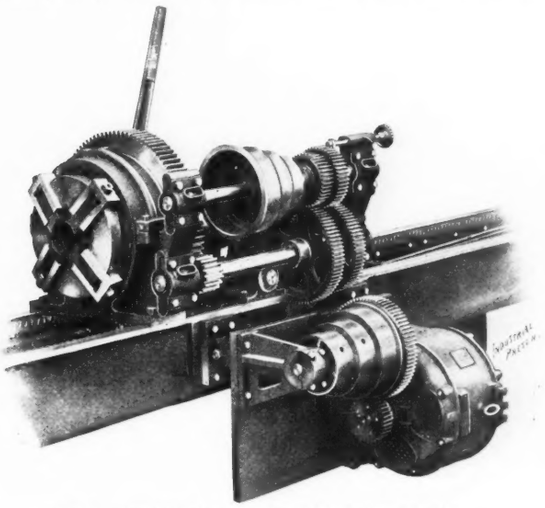


Fig. 1. Electric Drive of Boiler Tube Cutting Machine.

part of its circumference, and provide almost perfect rests.

The headstock is built with a lever chuck which is operated while the machine is in motion; in other words, after the grips in the chuck have been set for a certain size of tube, the machine can be run continuously while working on that one size of tube, and as the machine is run for a day or several days on the same size of work the lever chuck accomplishes a great saving in time. A separate set of grips is used for each size of tube. The grips are made of tool steel, tempered, and are turned to the exact outside diameter of the tube. The inside of the grip is left perfectly smooth and they hold the tube by friction only, but as they grip the tube around almost its entire circumference there is no likelihood of its slipping.

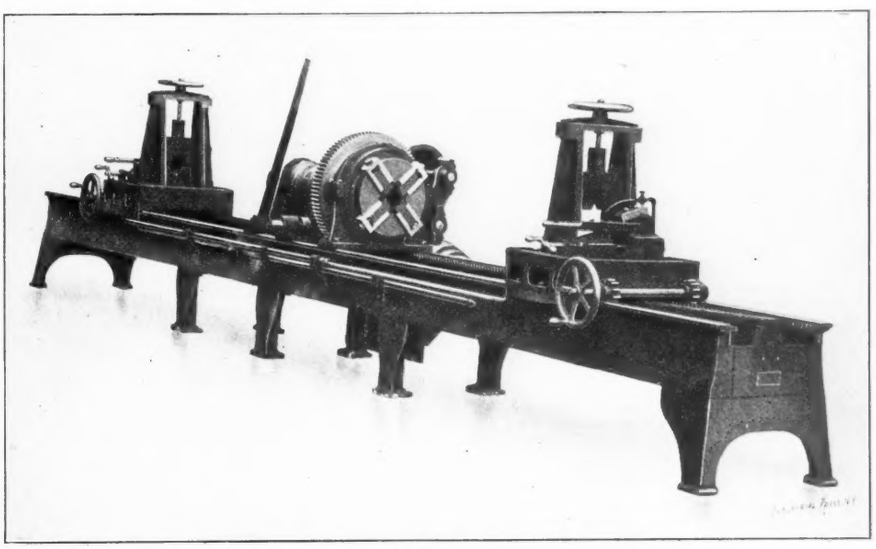


Fig. 2. Double End Boiler Tube Cutting Machine.

The machine is equipped with a 3 H. P. Westinghouse induction motor. The motor, shown in Fig. 2, is held on a swinging table which is hinged to the side of the bed. It is geared

into a countershaft supported on this same table. A short belt is run between the countershaft cone and the machine cone. The weight of the motor and the countershaft provides the necessary tension.

The machine is provided with an automatic oiling system, which keeps the cutting-off tools of both carriages continuously supplied with oil.

NUT MACHINE AND ANNEALING BOX.

The Ray Automatic Machine Co., of Cleveland, Ohio, have brought out an automatic nut machine, which is the invention of Mr. A. D. Ray.

The machine provides for punching the nut, piercing the hole, chamfering the corners and tapping the thread. The stock is fed to the machine from a coil upon a reel. The machine is fitted with two tapping spindles working alternately, that is, while a nut is being tapped under one spindle another nut is being punched and carried forward to the other spindle, so that no time is lost. Any style of nut can be made on this machine and by the addition of an extra spindle it will work irregular shapes.

It is capable of producing finished nuts at the rate of 30,000 per day.

This company has also placed on the market a steel annealing box, 18 x 10 x 10 inches, made of 18 gage sheet steel. This box is for use with "Vulcan" annealing putty which is produced by them. With it Mushet or self-hardening steels are easily brought into workable condition without in any way impairing the life of the material. Steel to be annealed is heated to a cherry red; then with the box about half full of the putty, it is placed as near the center as possible and covered with more putty until the box is full. It is then tightly packed down, the cover put on and the steel allowed to remain until it is cold. By this process the most stubborn steels may be readily and thoroughly annealed.

* * *

A number of readers desire to see drawings and descriptions of tool chests fitted for the tools that a tool- or die-maker should have. Photographs would add to the value of such contributions as they would give a better idea of the appearance and finish.

* * *

ADVERTISING LITERATURE.

THE GARVIN MACHINE CO., New York. "List No. 26" of new and second-hand machine tools.

THE STAR DYNAMO WORKS, Jefferson City, Mo. Pamphlet descriptive of the company's direct-current dynamos and motors.

L. S. HEALD & SON, 222 M. St., Barre, Mass. Pamphlet entitled "Nothing Succeeds Like Success," calling attention to the American center grinder of their manufacture.

THE TANITE CO., Stroudsburg, Pa. Circular of emery wheels. This describes the Tanite emery wheel, its productive capacity, its strength, evenness of wear, and other advantages.

WYMAN & GORDON, Worcester, Mass. Circular advertising the company's forgings, and containing a short story of Sir William Siemens. This is the seventh pamphlet with short accounts of the lives of noted engineers published, and we are informed others are to follow.

THE AKRON ELECTRICAL MFG. CO., Akron, O. Reprint in pamphlet form of an address by F. B. Duncan on the "Electrical Equipment in Modern Machine Shop Practice." Mr. Duncan is now connected with the Akron Co.

THE LAIDLAW-DUNN-GORDON CO., Cincinnati, O. Catalogue of pumping machinery. A full line of compressors is listed and illustrated and a number of useful tables on air, its weight, the flow of air in pipes, etc., are given.

THE CHICAGO PNEUMATIC TOOL CO., Franklin plant, Franklin, Pa. Standard illustrated catalogue of the air compressors manufactured by this company. These are designed for riveting, drilling, chipping, hoisting, but are also suitable for all other purposes where compressed air is used.

THE JEANESVILLE IRON WORKS CO., Jeanesville, Pa. "Advance Sheet No. 15," containing much information regarding the Jeanesville pump. Many half-tones and line cuts are used showing the different sizes and styles of pumps, and there are tables giving working data on simple and compound pumps.

THE LINK-BELT ENGINEERING CO., Philadelphia, Pa. Bulletin No. 1001, of the Renold silent chain gear used with electric motors. This chain and its several parts are fully described and illustrated, and it is shown in connection with motors for driving drill presses, boring machines, punches and a number of other tools.

THE AMERICAN BLOWER CO., Detroit, Mich. Illustrated sectional catalogue No. 141, of "A B C" pressure and volume blowers. These are shown in a large variety of styles. The "A B C" countershafts are also described and illustrated. Eight pages are devoted to a number of useful tables.

THE CINCINNATI SHAPER CO., Cincinnati, O. Catalogue A, Sept., 1902, of "Cincinnati" shapers. These include 16- to 24-inch crank shapers, single-geared and back-geared; 26- to 30-inch rack shapers, triple-geared; and a number of electrically-driven shapers. The "Cincinnati" traverse shaper is also described, several sizes and styles being illustrated by a number of fine half-tones.

THE PRATT & WHITNEY CO., Hartford, Conn. Pamphlet describing the new profiling machines recently brought out. These are made in two sizes, and are for finishing gun parts, sewing machine parts, etc. They are built with one or two spindles, the one-spindle profiler being made for manufacturers who do not need a machine for both roughing and finishing cuts at a single setting of the work.

THE DETRICK & HARVEY MACHINE CO., Baltimore, Md. Illustrated catalogue of open-side planers. This is a newly issued catalogue and gives a description and excellent half-tones of the company's 30-, 36-, 42-, 48-, 60-, and 72-inch planers. A number of views of the work that is done on these planers are also given. The company also manufacture drilling machines, bolt threaders, nut tappers, saw setting and filing machines, etc.

THE CROCKER-WHEELER CO., Ampere, N. J. Pamphlet entitled "A Crocker-Wheeler Trolley Trip." This describes a trip by trolley car over the Flint Division of the Detroit United Railway. The pleasant journey takes in Royal Oak, Rochester, Romeo, Oxford and Flint. The power station in Rochester, which furnishes the power used on this line, is described, together with the Crocker-Wheeler machines used therein, and several interesting illustrations of picturesque spots along the line are given.

THE CRANE CO., Chicago, Ill. 1902 pocket catalogue of steam goods. This is a very complete catalogue, cloth bound, and containing 464 pages, 12 of which are devoted to a very complete index. Valves, cocks, brass and iron fittings, steam and gas fitters' tools, engineers' and engine builders' supplies, wrought pipe, etc., are listed in this catalogue. The standard goods are first described and illustrated, then come the extra heavy goods; next the hydraulic and lastly, wrought iron and steel pipe—an arrangement which greatly facilitates the search for any particular kind of goods. Some useful tables are also given. It will be sent, upon request, to any one interested.

"AN INDUSTRIAL PROBLEM" is the title of a pamphlet upon cost keeping, gotten up by W. S. Rogers, Keene, N. H. It is designed primarily to call attention to the universal cost system devised by Mr. Rogers, but it contains reproductions of the various cost, material, record and other cards required, with an exposition of the system, and full directions for placing it in operation. The system is to be used in connection with a time clock; and for those who desire to adopt it in its entirety sets of cards, a time clock and accessories needed for a full shop equipment will be furnished by the inventor. In working out the system, the effort has been made to reduce the cost in the office, one clerk being required for a plant of considerable size. Further information will be had by addressing W. S. Rogers, Keene, N. H., and the pamphlet will be sent to those interested for 10 cents.

THE CLEVELAND AUTOMATIC MACHINE CO. (formerly the Cleveland Machine Screw Co.), Cleveland O. Handsomely illustrated catalogue entitled "The Cleveland Automatic." This is devoted to a description and illustration of the line of automatic machinery manufactured by this company. Some forty half-tone cuts are used to show the varieties of machines built, which include automatic turret machines from ¼-inch to 6 inch chuck capacity; automatic plain machines of from ⅝- ⅝- and 1¼-inch capacity; 2-inch and 18-inch automatic chucking machines, and the parts made on these; a two-hole turret machine for the rapid making of parts where only two tools in the turret are required; a tool and surface grinder; 4-inch and 6-inch worm milling machines, with samples of the work done on these machines, etc. Thirty pages are devoted to the description and illustration of the attachments to be used on the company's machines and which they carry in stock. These include magazine attachment, independent cut-off attachment, cross-drilling attachment, etc. Altogether this catalogue will prove of the greatest interest to those requiring this class of machinery.

MANUFACTURERS' NOTES.

THE DETROIT GRAPHITE MFG. CO., Detroit, Mich., report that their factory is working to its fullest capacity in taking care of current orders.

THE UNIFORM STEEL CO., formerly of Newark, N. J., have recently completed a new factory at Rahway, N. J., for the manufacture of high-grade crucible steel for lathe and planer tools, etc.

THE J. F. TOWSLEY MFG. CO., Evans, Gest and Berlin Sts., Cincinnati, O., manufacturers of wood-working machinery, are building an addition to their shop that will nearly double its capacity.

THE NAZEL MACHINE TOOL WORKS, Philadelphia, Pa., have moved into new quarters at 1046 Ridge Ave., and are making a full line of portable drills, portable keyseating machines, centering machines and pasteboard box machines.

THE NATIONAL-ACME MFG. CO., Cleveland, O., manufacturers of screw machinery, have opened an Eastern office at 510 Arch St., Philadelphia, under the management of Mr. L. M. Waite; also a Western office at 2 and 4 South Canal St., Chicago, with Mr. Geo. D. Grant as manager.

THE HENDEY MACHINE COMPANY, Torrington, Conn., manufacturers of lathes, planers and milling machines, are adding a three-story brick building, 63 x 140, to their works. Connected with this is a tower five stories high for water tank, etc., to supply the sprinkler with which their plant is equipped.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., who manufacture electric cranes and hoists, state that the demand for their products remains very satisfactory. They have recently received a large number of orders from well-known firms for cranes and hoists of various sizes, ranging from 3 tons to 30 tons.

THE DIAMOND DRILL & MACHINE CO., Furnace St., Birdsboro, Pa., builders of grinding machinery, have almost completely recovered from their recent fire and expect to have their new steel plant and iron foundry in operation within the next two months. They are also building a large blacksmith shop and doubling the capacity of their electric plant.

H. B. ROCKHILL, who for the past two years has been employed as superintendent for the United Cigarette Machine Co., Ltd., Lynchburg, Va., has purchased a two-story brick building, 50 by 100 feet, in Roanoke, Va., to be equipped as a general first-class machine shop. This will be known as the Rockhill Machine Works, with a capital of $10,000. The works will be in operation December 1st.

THE CROCKER-WHEELER CO., Ampere, N. J., held at their works in that city on Sept. 25 and 26 their annual managers' convention. A banquet took place on Sept. 25, for the officers of the company. Many interesting speeches were made. The object of the convention is to bring all the men closer together for the purpose of comparing notes and planning methods for handling the largely increased business.

THE PHILADELPHIA PNEUMATIC TOOL CO., Philadelphia, Pa., builders of pneumatic tools, report that the amount of goods shipped by them in August surpassed all previous records. They have had large orders recently from the Cambria Steel Co., the Pennsylvania Steel Co., two large shipbuilding companies, and the Grand Trunk Ry. Co., and also a number of orders from foreign parts. They have just added quite extensively to the machinery in their machine shop.

THE LUCAS MACHINE TOOL CO. Cleveland, O., manufacturers of horizontal boring, drilling and milling machines and power presses, are now occupying their new shop on Robison Ave., Cleveland. This has been entirely equipped with up-to-date tools, and the increasing demand for their product has made it necessary for them to consider a further extension.

FOOTE, BURT & CO., Cleveland, O., manufacturers of drilling machines, Cleveland, O., are just getting settled in their new shop, 1301-1303 St. Clair St. The building is 55 x 120, two stories, with boiler house outside, and contains a number of new machines, including a Dreses radial and several Reed lathes. A Maris electric crane has also been installed.